

Glimpses of Plant Life

Part I

Reading to Learn

Glimpses of Plant Life

Part I

BRIJ MOHAN JOHRI
BHARATI BHATTACHARYYA

Departmental Cooperation
R. D. SHUKLA



राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
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Front cover : Rauvolfia, Rauvolfia serpentina
Back cover : Water-lily, Nymphaea lotus

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Foreword

THE National Council of Educational Research and Training (NCERT) has been deeply involved in the development of curriculum, textbooks and other related instructional materials at various levels of school education for the last four decades. This has influenced, directly or indirectly, the curriculum and instructional materials of all the States and Union Territories of the country which is a matter of great satisfaction for the Council.

Generally, it is found that despite a good curriculum and textual materials, students rarely get encouraged and motivated towards self-study. One of the reasons for this is our examination system, which tests only the knowledge imparted through textbooks. Thus, very few students get motivated to read books other than textbooks. Moreover, the reasons for not reading books outside the course can also be attributed to the non-availability of an adequate number of books for different age-groups of children at an affordable price. Although during the last few years, some work has already been initiated in this direction by the Council to overcome this deficiency, it is insufficient.

Taking all these aspects into consideration, the Council initiated an ambitious and innovative project in the form of writing informative and enriching books for children of different age-groups under different themes covering science and technology, languages, literature, social science, biographies, stories, culture, etc. Under this project entitled, *Reading to Learn*, a series of books are being prepared for different age-groups of children in a simple and interesting style in different subject areas by the Council. In the area of science and technology alone, more than thirty-six books have already been developed under this project. We hope that we shall be in a position to publish a large number of books in Hindi and English in new and applied areas of science very soon.

In the development of books in scientific areas, we are seeking the cooperation and help of distinguished scientists, mathematicians

and experienced teachers. Each book is given a final shape after careful scrutiny and thorough editing in terms of language, style and subject matter. These books are being published at cost price in order to make them accessible and affordable to all children in the country. Further, there is also a proposal to get some of these books translated into other Indian languages. It is hoped that this project will also be received well like the other projects of the Council initiated in the fields of curriculum, textbooks and supplementary reading materials.

I am thankful to Prof B.M. Johri and Dr Bharati Bhattacharyya, the authors of 'Glimpses of Plant Life', Parts I and II, Prof. R.C. Mehrotra, distinguished scientist, who is the Chairman of the project, and to Prof R.D. Shukla, Head, Department of Education in Science and Mathematics for coordinating the project.

We will appreciate the comments and suggestions of children, teachers and parents for making these books more useful and beneficial for the target groups they are meant for.

J S. RAJPUT
Director

New Delhi
June 2001

National Council of Educational
Research and Training

A Few Words

This book is a small effort under the project *Reading to Learn*, of the National Council of Educational Research and Training. I was a little hesitant when Prof. J.S. Rajput, Director, NCERT, requested me to continue with the responsibility of getting science-related books developed under the project. My apprehensions were mainly due to awareness about the hectic schedule of my colleagues from the science community.

It has always been my endeavour to involve eminent intellectuals who have excelled in different disciplines of science and technology in this kind of work. I am of the opinion that only those scientists, who have experienced the thrill of discovery and research, can share their joy of achievement with children. I am grateful indeed to them for sparing some moments from their precious time for the benefit of the youngsters of the country. Children are the treasure of a nation and I am overwhelmed and, at the same time, satisfied, that our distinguished and busy scientists have happily agreed to make some meaningful effort for children. I am grateful to my scientist friends for acquiescing to my request.

In preparing these books, our main objective has been to present the subject matter in a manner that would attract and motivate the children to read. At the same time, the language of the text is simple so that children do not encounter any difficulty in unravelling the mysteries of science while reading these books. I believe that reading these books would inculcate and develop in them the reading habit, arouse their curiosity and encourage them to experiment and satisfy their curiosity.

This project has been given new impetus by Prof. J.S. Rajput, Director, NCERT, for which I am thankful to him.

I am grateful to Prof. Brij Mohan Johri and Dr Bharati Bhattacharyya who accepted my request for writing this book. I am also thankful to Prof. R.D. Shukla, Dean (C) and Head, Department of Education in

Science and Mathematics, the coordinator and editor of science books, for his sincere and dedicated efforts. Thanks are also due to Dr Shobha Laxmi Sahu for the assistance she has provided in the project.

I hope these books will facilitate development of the scientific temper from early childhood in the coming generations, and create a sense of national pride through a knowledge of the latest scientific developments in our country and glimpses of the endeavours of our scientists.

R C MEHROTRA

Chairman

Reading to Learn Project (Science)

Preface

IN 1978, the late Dr B.P.Pal, former President of the Indian National Science Academy, suggested to one of us (B.M. Johri) to give a lecture on 'Plants' to senior school students. The Academy's auditorium was overflowing and the response was overwhelming.

Due to the interest shown by the students, Dr Pal suggested that I (B. M. Johri) prepare a handy illustrated booklet for the students. Jointly with Dr (Smt.) Sheela Srivastava (then teaching at the Daulat Ram College, University of Delhi; now in the Department of Genetics, University of Delhi, South Campus), the booklet, *Famous Plants*, was prepared. This was published by the Academy in 1978. Later, a Hindi version, *Prasidh Paudhe*, was published by Rajpal & Sons, Kashmere Gate, Delhi.

We have always been interested in anecdotes and episodes connected with plants. So, we decided to prepare this book, 'Glimpses of Plant Life'. It is intended that after the English version in two volumes, the Hindi version will also be published.

Dependence on plants is not a recent happening in human civilization; it started with the appearance of the first man on earth. Today, they provide us with food, fodder, fibres, dyes, drugs, timber, spices, refreshing drinks, perfumes and a host of other commodities. Plants maintain atmospheric balance. Their reckless removal pollutes the atmosphere, causes droughts, floods and famines. Therefore, should we not learn more about plants — the love, hate, romance and the adventures and legends associated with plants and their discovery? It is important to know them, recognize them, name and classify them. It is equally exciting to know the folklores and old legends spun around them. It is certain that some plant commodities used today, were used by man centuries ago in a crude form. For his own benefit, by trial and error, man has learnt the various uses of plants.

'Glimpses of Plant Life', Parts I and II, point out all such details

The style and presentation are friendly, the information is laced with anecdotes, and references to original work are made wherever the history is traced. The simple, lucid language used in this book, we hope, will make it appealing to the readers—amateurs, professionals, and even the uninitiated.

University of Delhi
March 2001

BRIJ MOHAN JOHRI
BHARATI BHATTACHARYYA

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Echinocactus grusonii, *Cannabis sativa*, *Lodoicea seychellarum* (germinating seed), 'Coco-de-mer', and fruits of *Capsicum frutescens*; to Shri A.J. Chakrabarty (formerly of Indo-American Hybrid Seeds, Lucknow) for the photographs of *Ravenala madagascariensis* plants at Imambara, Lucknow.

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We are grateful to the members of both our families for their cooperation and moral support during the preparation of the present book.

AUTHORS

About the Authors

PROF. BRIJ MOHAN JOHRI

Brij Mohan Johri (born 11 September 1909, at Bijnor, U P) completed B Sc in 1931, M.Sc. in 1933 and D Sc. (first awardee) in 1936 from the Agra College, Agra University. He was awarded the Birbal Sahni Gold Medal in 1960 for outstanding contributions to Botany.

He has published about 200 original research papers, reviews and monographs in national and international journals, over 150 additional articles have been published by his students and collaborators. He has to his credit eleven books.

Several books have been published by Springer, Heidelberg: *Experimental Embryology of Vascular Plants*, *Embryology of Angiosperms*, *Comparative Embryology of Angiosperms* and *Botany in India. History and Progress. The Gymnosperms* (Chhaya Biswas and B.M. Johri, 1997, pp i-xxi+1-494); *Flowering Plants: Taxonomy and Phylogeny* (Bharati Bhattacharyya and B.M. Johri, 1998, pp i-xxi+1-753) and *Reproductive Biology of Plants* (eds. B.M. Johri and P.S. Srivastava, 2000, pp i-ix+1-320) have been published by Narosa Publishing House, New Delhi, in collaboration with Springer, Heidelberg.

Other books under publication are. 'History of Biological Science' (B M. Johri and Bharati Bhattacharyya) by Allied Publishers, New Delhi. The books under preparation are: 'The Bryophytes', 'The Pteridophytes', 'Dictionary of Archegoniate Plants', and 'Embryology of Angiosperms'.

DR BHARATI BHATTACHARYYA

Dr Bharati Bhattacharyya is currently Reader in the Department of Botany, Gargi College, University of Delhi. She obtained her Master's degree in 1964 and completed her Ph.D. in 1969 from the University of Delhi. Dr Bhattacharyya has more than 32 years of teaching and research experience.

Her work emphasized the importance of taxonomic studies as early as the 1960s, particularly in the family Leguminosae. Her interests include ecological studies also She presented a paper entitled, 'Ecological Study of Plant Species Diversity in Delhi Region' at the International Congress of Ecology, Yokohama (Japan) in 1990.

She has published more than 20 research papers and scientific articles in national and international journals. She has co-authored with Prof. B M Johri a book entitled, *Flowering Plants. Taxonomy and Phylogeny* in 1998, published by Narosa Publishing House, New Delhi in collaboration with Springer, Heidelberg. She is the co-author of several books (under publication) which include 'History of Biological Science' being published by Allied Publishers, New Delhi.

Recently, she has been awarded a grant for a research project entitled, 'The effect of environmental changes on some selected herbaceous plants of Delhi' by the University Grants Commission, New Delhi.

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Introduction

IN recent years with the increased awareness of the natural environment, people are realising the importance of plants more than ever before. Almost everything that we need in our daily life is provided by plants. As our needs know no bounds, the importance of plants is felt in every field. The plants have provided us with our basic needs like food and shelter since the prehistoric times. By two million years ago or even earlier, the ancestors of modern man were living close to water sources on the forest fringes and depended for their food on plants and small animals. They soon took to farming and became 'food producer' from 'food-gatherer'. They also learnt to domesticate animals and discovered that for many ailments, the plants were the remedy. A medical papyrus from Egypt, estimated to date from 1600 BC, contains a list of medicinal plants and their uses.

The plants are of immense use to humanity. From times immemorial, they have influenced man's economic, cultural and political history. For all times to come, man will remain utterly dependent upon these primary producers. They capture the solar energy and photosynthesize food products.

From the prehistoric period, through all these centuries,

the number of useful plants and their uses have increased to an amazing degree.

It is not only interesting to know how the plants are of such great importance to us, it is also exciting to explore through the old legends "how man came to know the uses of particular plants" and how a particular plant was procured from one place and grown elsewhere.

What makes some plants famous? The redwood tree or *Sequoia*



FIG. 1.1

Narcissus, flowers as beautiful as the handsome young man who fell in love with his own reflection.

of California is known because of its great age, which ranges between 2000 and 4000 years. The foxglove or *Digitalis* (Fig. 2.1) yields the drug digitaline commonly given to heart patients. The quinine plant, *Cinchona* (Fig. 2.3), is famous because the extract of its bark was used by the natives of Southern and Central America to cure Malaria.

There are many other medicinal plants which attained notoriety or fame because of their characteristics and utility.

Of considerable importance are the spices. During 15 and 16 centuries, much of the exploration of the world was in search for the spices. At one time, the spices had been so important as to have been used as a currency. In 950 BC when the Queen of Sheba went to meet Solomon, she took camel-loads of spices as a present for him.

The flower of *Narcissus* (Fig. 1.1) with its white petals is as beautiful as the legendary handsome young man who pined to death after he saw his own reflection in a pool of water and fell desperately in love with himself. This was a curse of the beautiful wood-nymph Echo, whose love was not reciprocated by 'Narcissus'.

The Olive trees (*Olea europaea*) can certainly live for 800 to 1,000 years. According to tradition, the ancient trees which now stand on Gethesmane (Israel) are the very trees mentioned in the Bible (Zohary 1982)

The ripe fruit of durio (*Durio zibethinus*) (Fig. 1.2) has large seeds with an aril that is extremely sweet to taste. If, however, the fruit over-ripenes, its stink is unbearable. Therefore, the epithet 'Fruit with the Taste of Heaven and Smell of Hell'.

The giant water lily (*Victoria amazonica*) (Fig. 8.3) with its huge circular leaves was discovered in South America in 1801. The generic name *Victoria* commemorates Queen Victoria who was presented with a leaf and a flower of this new wonder in 1849, the specific epithet *amazonica* reminds one of its native land (the river Amazon in South America).

The unripe coconut fruit is essentially used in many Hindu religious occasions like birth, death and many more. The 'water' of

green fruit is a sweet refreshing drink. A Philippine variety (meca panu) has the central fruit cavity completely filled with spongy kernel (Fig. 7 6) which is highly prized as an additive to fruit-salad and



FIG.1.2

Durio zibethinus — fruit with the taste of heaven and stink of hell

dressing on ice-creams. The doublecoconut (*Lodoicea seychellarum*) (Fig. 7.4) is endemic to Seychelles Island in the Arabian Sea. This is the largest fruit and contains the largest seed weighing 27,000 gms. The half-portion of the shell of the fruit is used as a 'begging-bowl' by hermits and saints

Plants with insect diet usually grow on nitrogen-deficient soil and have special mechanisms for trapping and digesting insects — *Drosera* (sundew) (Fig. 5.1A), *Nepenthes* (pitcher plant) (Fig. 5.5A), *Utricularia* (bladder-wort) (Fig. 5.3A,B) are some of them.

A cup of tea (*Thea*) (Fig. 4.2A,B) or coffee (*Coffea*) (Fig. 4.3A,B) cheers many of us in the morning. It is the decoction we drink but it is said that when tea was first introduced in England, the decoction was discarded and the boiled leaves were munched placing them in between the buttered toasts. What a novel way of having tea!

A curious 'service-boy' (in an eatery) decided to taste the decoction and did so secretly. His co-worker wanted to know about their companion's secret. Gradually, all of them tasted the decoction of tea, liked its aroma and stimulatory effect. Thus, the practice of taking tea changed, and became a world-wide phenomenon.

The orchids (Fig. 13.4A,C, 13.5A,B, 13.6A,B) are the flowers of excellence. It was not until 1731 that the first orchid entered western collections. Some of these were grown in earthern pots, in compost of rotten wood and decayed leaves. These were plunged into a pit containing tanniniferous substance (Hawkes 1961). It is a wonder that they not only survived but also blossomed!



The Plants That Heal

THE therapeutic agents in various plants are certain groups or specific substances which are the products of plant metabolism. These active principles may be 'toxic', i.e. with poisonous effect to the animal organism or 'non-toxic', i.e. with therapeutic effect. It is impossible to draw a precise line of division between the two, for even certain apparently harmless plants—the aromatic species containing essential oil, for example, may affect the functioning of certain body organs, if used in excessive quantities or over a longer period than prescribed. Symptoms of mild poisoning like nausea, diarrhoea or intestinal pains or cramps may not be fatal but are unpleasant. Only those plants should be branded as toxic when the intake of a minute quantity may show poisonous effect. Acutely poisonous plants are used in the treatment of certain specific diseases in very small doses. The same substance may be extremely dangerous from the hands of a non-qualified person, and a boon from the hands of a qualified medical practitioner.

Amongst the principle groups of active substances in various plants, 'alkaloids' are most important, chemically distinct as they contain nitrogen. They are stable, crystalline, colourless and odourless substances sensitive to high temperature.

Several hundred medicinal plants are known to modern science. The first alkaloid was isolated in 1803 by Friedrich Wilhelm Adam Sertürner (1793-1841), a pharmacist's assistant in the German town of Padarborn. It was morphine, the basic alkaloid from opium poppy. This was followed by the isolation of strychnine (1818), quinine (1820), coniine (1827), nicotine (1828), atropine, hyoscyamine and colchicin (1833).

Another group of chemicals with medicinal values are the 'glycosides'. Chemically they consist of a sugar portion attached by an especial chemical bond to a non-sugar portion. These have poisonous effect on man. But, when the heart muscles become old and inefficient, the cardiac glycosides come to the rescue. Cardiac glycosides are obtained from *Digitalis lanata*, *D. purpurea* and also from *Adonis vernalis* and *Convallaria majalis* — commonly called the Lily-of-the-Valley.

Some essential oils — usually volatile and fragrant terpenes or terpenoids also have therapeutic uses.

Astringent properties of tannins — a group of organic, non-nitrogenous plant products, make tannin-containing plants useful.

Some of the organic acids — oxalic, malic and citric acid have mild laxative effect.

The ancient literature from different countries of the world shows that herbal drugs have been both used as well as abused from time immemorial.

Foxglove .

The name of this medicinal plant was first mentioned in the year 1250 in the writings of Welsh physicians. In 1785, another well-known physician William Withering from Birmingham, England, while

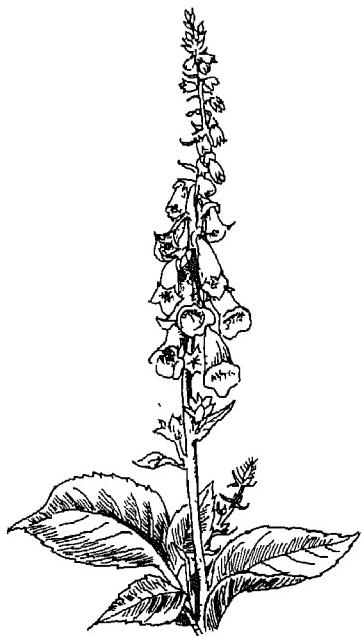


FIG 2 1

Foxglove, *Digitalis purpurea*, yields the cardiac stimulant 'digitoxin'.

on a routine visit to a village met a patient suffering from acute pain in the chest. He recognized it as cardiac arrest and did not think that the patient would survive. On his return journey, however, he was amazed to see the patient absolutely normal. On enquiry he came to know that the patient was given an extract of the foxglove plant (Fig. 2.1). This is how the specific nature of the drug was accidentally discovered. At present it is the best medicine for congested heart failure.

In 1766, the young doctor, William Withering, while treating a girl also used to bring wild flowers for her to sketch. This girl who later on became his wife, was responsible for getting him interested in plants.

The drug was first introduced into medicine as diuretic (stimulant of urine secretion) in dropsy in 1775 by Withering. He recognized it as the active ingredient of an old woman's secret formula. Withering began extensive experimentation with the foxglove plant and after 10 years he produced his medical classic : *An Account of the Foxglove and Some of its Medical Uses with Practical Remarks on Dropsy and other Diseases*. He observed that the active principle was in the leaves while the plant was in bloom.

Withering suggested the use of foxglove to Dr Erasmus Darwin

(grandfather of Charles Darwin) for the treatment of a dropsy patient. In 1780 Darw in published the paper in which he claimed the first use of digitalis (foxglove) in medical practice without giving any credit to Withering. This was five years before Withering's publication.

Native of Canary Islands, and western Europe to Central Asia, the plants of *Digitalis purpurea* (Fig. 2.1) are grown in the gardens as an ornamental. Their tall spikes with hanging tubular flowers are beautiful. The scientific name is due to its flowers resembling a finger, 'digitus' in Latin. In southern Scotland it is called 'bloody fingers', farther north as 'dead men's bell' and in Ireland as 'fairy thimbles'. Its Hindi name is 'tilpushpi' which means that the flowers are like that of the 'til' plant *Sesamum indicum* (Jain 1968).

The dried leaves of the plant contain about a dozen chemically- and physiologically-related cardiac or steroid glycosides, three of these have been isolated in crystalline form — digitoxin, gitoxin and getalin. The main use of the drug is in heart diseases as it stimulates the activity of the muscular tissue around the heart, and helps in forcing more blood into the coronaries.

While digitalis is still the best-known cardiovascular drug, two more uses have been discovered: (a) in curing glaucoma, an eye disease, and (b) in the treatment to slow the fatal progress of muscular dystrophy, a hereditary disease. However, it is still one of the tricky drugs which must be administered according to each individual's reaction.

Belladonna

The Romans were aware of various types of poisonous plants, Belladonna is one of them. Plutarch who wrote about many Greeks and Romans gave an account of how the Roman army under the command of Mark Anthony was poisoned by belladonna when they were eagerly looking for food during their retreat from Parthians.



FIG. 2 2

Belladonna, *Atropa belladonna*, source of the drug 'atropine' that helps in dilating the pupil of the eye.

and roots the drug atropine is extracted for medicinal use. It is mainly used for dilating the pupil of the eye for examination.

Its dangerous juice did not stop the Spanish ladies of yesteryears from making a cosmetic out of its fruits to whiten their complexion. The women of Southern and Central Europe where this plant is native used one or two drops of the diluted juice of its fruits in their eyes to make them appear more attractive although they were aware of the

The same plant made it possible for Macbeth — King of Scotland to win a victory over his enemy who was supplied with food and drink poisoned with belladonna and then massacred. Cleopatra is known to have studied a large number of plants in search of a suicidal poison. She used her prisoners and slaves as guinea-pigs. It is reported that she was not happy with the effect of belladonna as it produced too much pain in spite of the desired action.

'Deadly nightshade' or belladonna (*Atropa belladonna*) (Fig. 2.2) bears dull-green leaves on profusely branched bushy stem, purple flowers and purple black berries. Just three of these berries are enough to kill a child. Yet, the plant is cultivated in Switzerland, France, southern Germany, and some parts of USA. From its leaves

damage caused by excessive use of this drug. Anyhow, they could not get rid of the custom.

The name 'belladonna' is derived from two Italian words: *bella* means beautiful and *donna* means lady. The scientific name *Atropa* is derived from the word 'Atropos', one of the three Fates which cut the thread of life, thereby meaning that the plant is poisonous in nature. The 'dancing girls' used atropine to dilate their eyeball to appear even more beautiful. Due to repeated use the eyeballs lost sight and the dancing girls became blind.

The dried leaves and tops collected when the plant is flowering, contains a large number of alkaloids of which hyoscyamine and atropine (the tropane alkaloids) are well-known. Because of its poisonous nature, its therapeutic dosage is very low.

Quinine

Malaria has been one of the killer diseases amongst the infectious ones, particularly in the tropical countries. The drug quinine extracted from the bark of *Cinchona* tree is the only remedy known so far.

Native to the warm, moist Amazonian slopes of the Andes from Colombia to Bolivia at elevations of around 5,000 to 8,500 ft. *Cinchona* spp. are medium-sized trees with fissured bark, and white bunches of flowers (Fig. 2.3).

The medicinal value of the bark was not known to the ancient civilization of the Incas. Two publications around 1553: *Royal Commentaries on the Incas* by Garcilaso de la Vega, and *Chronicles of Peru* by Pedro de Cieza de Leon also do not mention about this tree. The first written record of its use occurs in a religious book: *Chronicle of St Augustine* written in 1633 by Father Calancha of Lima, Peru in



FIG. 2.3

Cinchona, source of the antimalarial drug quinine.

South America. The cinnamon-colour powder of the bark of a tree named 'the fever tree' in Loxa (now Loja of present-day Ecuador), when given as a beverage cures the fever. A variety of colourful legends are available about this discovery.

After a storm a tree fell into a nearby pond. In about a few days time the water turned out to be too bitter to be consumed and the local people abandoned the pond. A stranger who was suffering from high fever and passing by this pond drank the water as he had no other choice. And it was a miracle that he was cured of fever. Later, he told the people about this discovery and advised them to make use of this remedy. (*Cinchona* bark soaked in cold water gives a bitter taste.)

Another often-repeated story is that the Countess of Cinchon, wife of the Viceroy of Peru, was the first to use and introduce the bark to Europe in 1638. This tale, however, was disproved by A.W. Haggis in 1941 as the lady concerned never had malaria and died at

Cartagena on her way to Spain and hence could not have carried the cinchona bark to Europe.

Yet another version is that the bitter taste of the bark was known to the Jesuits of Lima about 1630, as they used to distinguish between trees by chewing their bark, and they discovered the medicinal properties of the bark also. This is the reason why it is known as 'Jesuit's Bark' or 'Peruvian Bark'. The first mention of cinchona in European medical literature is in the book: *Discours et Advis sur les Flus de Ventre Douloureux*, written by Herman van der Heyden, in 1643. The first medical use of cinchona bark was made in 1649 by Cardinal John de Lugo when he showed the peruvian bark to be the most effective treatment for Roman fevers.

In 1670, a young medical student Robert Talbor started treating malaria-patients with a secret drug. He was knighted in 1678 for curing Prince Charles II. He always used to advocate that fever bark or cinchona was the most dangerous medicine and his mysterious drug was the best. However after his death, the formula of the secret drug was found to be nothing but a mixture of rose leaves, lemon juice and a strong infusion of Peruvian bark!

The credit for the discovery of the correct method of administering the drug goes to Dr Sydenham and the chief constituents were isolated by two Frenchmen, Joseph Pelletier and J.B.Caventon in 1820. Based on the native name for the bark, 'quina', they named the alkaloid as 'quinine'.

Destruction of these trees continued for about 200 years. When this was realised, attempts were made to cultivate this indispensable drug plant.

For this purpose, J.K. Hasskarl for the Dutch, and Sir Clements Markham for the English were sent to South America between

1859-1863. Both the expeditions failed as the best-quality seeds of high quinine content were not collected. Later on, Charles Ledger of Puño, Peru, collected and sent one pound of seeds from the banks of the upper Marmoré river in Bolivia. The progeny of these and subsequent laborious and skilful work by the Dutch resulted in the largest source of quinine in Java. This species is therefore named *Cinchona ledgeriana*; trade name 'Ledger Bark'. It is the commonest species grown in India too, the others are *C. calisaya* (calisaya or Peruvian Bark) and *C. succirubra* (Red Bark). The alkaloids are : quinine, quinidine, cinchonine and cinchonidine. Quinidine is a life-saving drug. It steers the heart out of auricular fibrillation.

The drug quinine brings down temperature quickly, and with regulated doses checks relapse of malarial fever. However, high doses can cause temporary or permanent deafness, blindness and nausea. Pregnant women and persons suffering from heart diseases should not be administered quinine preparations.

Sarpagandha

Since ancient times, the roots of 'Sarpagandha' have been used in India as hypnotic and sedative in neuropsychiatric disorders. Some of the alkaloids in the roots are used as anti-hypertensive. It is presumed that this plant has been known to Indian medicine for about 4,000 years.

There are many folk-lores about this plant, scientifically known as *Rauvolfia serpentina* (Fig. 2.4). According to one such story, a mongoose chews the leaves of this plant to gain strength before a duel with a cobra. According to another, freshly-ground leaves applied to the toes (of the feet) act as an antidote for snake poison. Yet, another story mentions that a mentally-deranged person could be brought back to normalcy if he ate the root pieces of *Rauvolfia* plant.

During the era of Pre-Aryan Indians, magics and charms and rituals were the general treatment catered to patients. But, their medical knowledge included inorganic remedies, secret herbs, animal cures,



FIG 24

Rauvolfia, *Rauvolfia serpentina*, 'Sarpagandha' has long been used in India against fevers, snake bites and insanity.

and venoms as well. There is evidence to show that as early as three millennium (3,000,000) ago, 'Sarpagandha' was used in India to treat fevers, snake bites and insanity (Sahu 1979).

During the Vedic and Post-Vedic periods also this plant was used as a drug. It has been mentioned in *Charaksamhita* — an ancient medical treatise written by Charaka (800-1000 BC). The practitioners of Ayurvedic medicine were supplied the roots of 'Sarpagandha' by the 'herb-gatherers'.

The astonishingly diverse type of therapeutic nature of this drug plant spread to the Arab countries, and the Arabian 'Hakims' got interested in it. Regular lectures on the *Rauvolfia* plant were delivered in the Medical Schools.

Kirtikar and Basu (1918) were the first to publish the important report about the therapeutic application of this drug in hypertensive diseases. A coordinated effort of botanists, chemists, biochemists, and pharmacologists has revealed the mysteries of the *Rauvolfia serpentina* plant.

Plumier (1703), the pioneer botanist of the Caribbean, suggested the scientific name *Rauvolfia serpentina* which is based on the name of a 16th century German physician Leonard Rauwolf, and *serpentina* — because of the snake-like roots.

A member of the family Apocynaceae, the *Rauvolfia* plants are evergreen shrubs reaching a height of about 30-75 cm, with whorled leaves and clusters of white or pink flowers. Fruits small, round berries, deep purple or black when ripe. Endemic to India, it occurs almost all over the country from sea-level to an altitude of about 1,000 meters, although more in the lower belts of eastern and western Himalayas, and at similar altitudes of the Eastern and Western Ghats (South India).

As the roots contain the active principles, the plants are uprooted (and killed in the process). In India alone, the total annual requirement of the drug is about 12,000 quintals. Therefore, methods must be adopted for speedy regeneration of the plants. Indiscriminate collection of roots has depleted the wild resources in India.

Development of *in vitro* techniques has offered a great potential for rapid multiplication and conservation of these plants. In *Rauvolfia* low temperature incubation appears to be highly promising as the cultures could be preserved for 15 months at 15°C temperature (Sharma and Chandel 1992). Later, the *in vitro* multiplied plants can be successfully transferred to the field. As *Rauvolfia serpentina* is an endangered species as recorded in the report *Threatened Plants of India* (Jain and Shastri 1980), the above-mentioned method may be employed to increase the number of plants.

The different alkaloids obtained from *Rauvolfia* are : Reserpine, Ajmalcine, and Rauvolfine (from *R. canescens*). Reserpine and Ajmalcine are used in hypertension and insanity, and rauvolfine as sedative, hypertensive and in skin ailments. As the sedative action of the drug is slow, it cannot be used successfully in acute cases. But, it is a good medicine in mild forms of anxiety or in cases of chronic mental illness.

Ginseng

Long ago in China, a beautiful Chinese maiden married a handsome young aristocrat. But they were not blessed with a child for a long time, and the husband started thinking of a second marriage. Then one night, the wife had a dream that an elderly, divine sage asked her to go to the mountains and fetch a plant whose roots resembled a human-being. Her wish would be fulfilled if a drink made from the roots was consumed by her. She did as advised and in due course of

time gave birth to a son. She went to the mountains again to thank the sage who was very happy and planted this plant all over the area.

Well, this is the plant of Ginseng, variously known as 'Wonder of the World', 'Man-root,' Man-essence', 'Thunderbolt root', 'Seed of the Earth', 'Holy Herb', etc. It is a 'magical' plant known all over the world today. Ginseng has been used in Chinese medicine for more than 4,000 years. The earliest Chinese Herbal, which refers to the use of this plant, is *Shen-Nung Pen Tsao Ching*. This appeared for the first

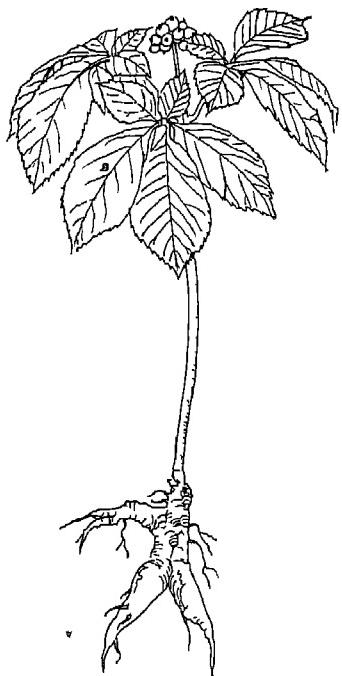


FIG. 25

Ginseng, *Panax quinquefolium*,
the 'magic' plant of the
Chinese medicine.

time in written form in the first century BC. The Chinese name of the plant has been translated in the western world as 'Man-shaped root' or 'Man-essence'. The word is derived from the shape of the root, which resembles the form of a man. Harvesting ginseng roots was the main feature on which the ancient Chinese legends were based. It is said that a special group of ginseng-hunters called 'va-pang-suis' looked for this plant at night with tiny bows and arrows. The plant, as it is said, emitted a light of its own and moved about at night. They could collect these roots only with the help of the tiny arrows with strings attached to them. Dr James Duke, a researcher at the USDA (United States Department of Agriculture), Economic Botany Laboratory, doubted the

Chinese belief that ginseng plants moved around at night. He planted 100 plants in his experimental garden only to find next morning that half the plants had moved out! He planted back the uprooted plants, and the same episode repeated next morning. Dr Duke now had to agree to this unbelievable Chinese saying. In old Chinese medicine, the more the root resembles a human-being, the more potent its healing properties are.

By the first century AD people were aware of the magical property of ginseng. Digging of the plants from the jungles of China was continuing with great speed. Many a war was fought between the Tartars and the Chinese. One of the Tartar kings surrounded his kingdom with strong wooden poles to stop the theft of ginseng. In China large store-houses were made for the collection of its dry roots. These store-houses were well-protected against any theft. Anyone guilty of taking the dried roots out of the country, was given capital punishment.

Ginseng comprises *Panax ginseng* (Korean ginseng) and *P. quinquefolium* (Fig. 2.5; American ginseng). A third species, Siberian ginseng is a misnomer as it refers to *Eleutherococcus senticosus* used as a substitute (Husain 1992). The knowledge of the plant and its medicinal use became known to the Western countries through a Christian missionary who worked in China in the early 1700s. Ginseng has been exported to North America and finally cultivated in USA. *P. ginseng* is indigenous to northern China and Korea, and cultivated in China, Korea, Japan and partly in Russia. *P. quinquefolium* is a native of Quebec, Manitoba, and north-eastern USA, and cultivated in USA — Wisconsin, Georgia, Tennessee, Kentucky and North Carolina. This species grows alongwith other shade-loving plants, usually on shady northern slopes with loose, rich soil of the mountains.

Propagated by seeds or roots, it is a challenging plant to grow. The plant must grow for six to seven years before being harvested, as it is said that the root gets better with age. The clean, fresh root is supposed to contain maximal active principles : saponins — ginsenosides or panaxosides. It is prescribed as a tonic, stimulant and aphrodisiac — used in neurasthenia, dyspepsia, palpitations and asthma. The drug is said to enhance natural resistance power of the body (Husain 1992). The Chinese and native American tribes both use ginseng to treat impotence. The Chinese use it against many other ailments such as senility, debility, diabetes, hypoglycemia, uterine disorders and mental illness caused by nervous exhaustion (G Weiss and S. Weiss 1985).



Biblical Scenario

THE groups of Semites (named after Shem, described in *Old Testament* as the eldest son of Noah and the ancestor of the Hebrews) settled along the eastern coast of the Mediterranean sea 5,000 years ago. From amongst these people arose the Hebrews who started the worship of only one God (and abandoned the worship of many Gods). This God of theirs was just and merciful but demanded that his followers should believe in the rules (laws) set aside for them. This new belief in a single God gave rise to Jewish faith and later to Christian faith.

The original Semites were herdsmen and hunters but they soon became farmers. The coastal land, that they settled in was known as Canaan in the Bible. After many fierce wars were fought, by 1150 BC, the Canaanites were pressed into the narrow coastal strip of the present-day Lebanon and were known as the Phoenicians. Among the Phoenicians, it is believed, that the 'alphabets' first evolved.

The city of Byblos was an important Canaanite town and remained so for a long time. Inscriptions in the original alphabetic writing (1,300 BC) have been discovered in Byblos. The Phoenicians found a better method of keeping their written records. Instead of using the tablets of baked (or burnt) clay, they started using 'papyrus' scrolls

made of reeds from the river, split into strips and stuck together. The Phoenicians also took 'papyrus' to Greece. The Greeks coined the word 'biblia', from the city of Byblos, to describe the books they made from it. The English name Bible has its root in the Greek word 'biblia'. 'Papyrus' itself is the source of the word 'paper'.

In this Chapter, some of the well-known plants growing in the Biblical Land of Israel are discussed.

Olive

The olive abounded in biblical days both in the mountains and in the coastal plain of the Biblical Land of Israel. The agricultural significance of olive during biblical period is evident from many scriptural references to olive groves, olive trees, and olive oil. The vernacular name, Zaitun (in Hindi), is derived from the 'Hebrew' Zaijit or Etz-zayit.

The olive leaf is symbolic for peace; has heralded new life and hope ever since the early history of mankind. This is indeed expressed so well in the Biblical story of the flood : "And the dove came back to him in the evening and lo, in her mouth a freshly-plucked olive leaf; so Noah knew that the waters had subsided from the earth."

In another folklore, all the other trees went to Olive tree and appealed to him to reign over them. But the Olive tree said to them: "Shall I leave my fatness, by which Gods and men are honoured, and go to sway over the trees?" The righteous as an individual and the integrity of the People of Israel were metaphorically likened in the Bible, to this evergreen tree.

The tree and its fruit were very well-known and, in addition to its use in daily diet, the oil was used in holy ointments of kings and priests, for anointing the sick, for lighting home and the temple, and

even as a solvent for various spices, incences and aromatics used as perfumes and in cosmetics. The wood was used for making wooden ornaments and household utensils.

In biblical times the oil was expressed from the olives by crushing them with a revolving stone. A stream of oil spouted from underneath the stone into a cistern dug in the ground. Such oil presses were at the foot of the 'Mount of Olives'. So exuberantly did the oil flow there, and so picturesque were the surrounding oil groves, that this site derived its name therefrom : Gethesmane (Hebrew : Gat-Shmanin = oil-press). Olive trees can live to a very great age, certainly for 800 to 1,000 years. According to tradition, the ancient trees which now stand on Gethesmane are the very trees mentioned in the Bible.

Olive, *Olea europaea*, is cultivated from the Mediterranean region to the southern slopes of the Caucasus, in South Africa, India, Japan, and Australia, and from California and Florida to Chile and Argentina. Flourishing among the rocks and on poor soil, rich groves of olive trees are scattered on the mountain slopes of Galilee, Samaria and Judea, crowned by the Mount of Olives in Jerusalem.

In appearance and foliage, the olive tree is reminiscent of the white willow. The trunks of older specimens are frequently hollow, very gnarled and often assume fantastic shapes; some look as if they were growing on stilts. Leaves are leathery and evergreen; grey below and blue-green above. Clusters of small white flowers are pleasantly fragrant and are shed soon after pollination. The fruit is a one-seeded drupe.

In olive groves, specially in the South of France, the trees are kept low by pruning. To obtain the particularly fine 'Provence' oil, the fruit is gathered carefully by hand, dried, the stones removed, and the oil expressed from the pulp.

In Israel and other Mediterranean countries, the tree often grows wild and is considered a variety of the cultivated species, *Olea europaea* var. *oleaster*, which is considered to be the ancestor of the cultivated olive. Although there is uncertainty as to where it was first cultivated, the fact that it has been unearthed in Israel at the north of Dead Sea from the Chalcolithic (3,700 BC) layers, makes one assume that this country cradled the cultivated olive tree. Moreover, Olive pits have been discovered in variously dated excavations and sites.

Date Palm

The Date Palm is one of the Holy Land's ancient fruit trees. It has been mentioned a number of times in the Bible. The date palm tree was considered a symbol of upright stature, justice and righteousness. Its leaves are among the 'four species' for the feast of Tabernacles, and it continues to symbolise holiness and resurrection in Christian worship. Jericho, presumed to be the oldest city in the world, is called in the Bible as the 'City of Palm Trees'. The Arab town in Sinai, El Arish, stands for huts — huts made of palm leaves.

Date Palm was so strongly established as a symbol for the people of Israel that after conquering the land (first century AD), the Romans issued coins which showed a mourning woman — Judea Capta or 'Judea in Captivity' underneath a palm.

Palm trees and leaves were used as motifs by King Solomon in Temple engravings and sculptures. In the Capernaum synagogue (from 3rd Century AD) carved palm branches have been observed. The Maccabees (2nd century AD) used the palm as the emblem of victory on their coins.

Apart from the spiritual imagery, the Bible also mentions about various other uses of this plant. Its fruits are sustaining, its honey



FIG. 3.1

Date Palm, *Phoenix dactylifera*, the Holy Land's ancient fruit tree.

refreshing; and from the trunk a tasty juice could be obtained. The leaves were woven into mats, hats, baskets, etc., and the wood served for fences, roofs and rafts.

The date palm is primarily a plant of desert oases. The earliest remains of the cultivated date palms have been discovered from the Ubaidian (4,000 BC) and Chalcolithic (3,700 BC) at several places in the near East, particularly in the tropics. The wild date palms are fairly well-distributed near brackish rivers and springs all along the Sahara desert from the Atlantic Ocean to the Persian Gulf, forming wild oases inhabited by saline or semi-saline plant communities. It was from these oases that the date palm trees were taken into cultivation. It was probably first grown in or near the 'Fertile Crescent' of south-western Asia, i.e. Mesopotamia or the present day Iraq, as early as 5,000 BC. The Arabs introduced it to North Africa and Spain. From Spain, date palm was introduced to Mexico a few centuries back, and to California in 1765.

Presently, it is intensively cultivated in the Jordan and Aravah Valleys, the Dead Sea area and the Coastal Plain, mainly in the El Arish and the Gaza districts.

The generic name *Phoenix* is probably derived from the date palm cultures of the coastal region of Phoenicia. Of the 30 species, only a few yield edible fruit. It is a remarkable fact that, like the cultivated olive trees, the date palm is a geographic digression of an almost exclusively tropical palm family — the Arecaceae — comprising about 4,000 species growing in both the New and the Old World (Zohary 1982).

Date palm is a tall robust tree attaining a height of 25 to 30 m or more; stem unbranched; with numerous sucker shoots arising from the base of the stem (Fig. 3.1). If these suckers are left to grow as

such, they will grow into subsidiary trunks and give the plant a clumpy appearance. The trunk is straight and rough in appearance as it is closely beset with the persistent leaf bases. The leaves are very large, forming a handsome crown and between 10 and 20 new leaves are produced each year and as many are shed during the same period. Four to eight meter long pinnately-compound leaves have 20 to 40 cm long, stiff, greyish-green leaflets that are arranged two-ranked or sometimes four-ranked; often modified into spines. The date palm is dioecious, male and female inflorescences are very much alike. The flowers are normally wind-pollinated. In ancient times in some Arab countries, however, priests took the male inflorescences and dusted the pollen on female flowers as religious ritual, although they were unaware of the process of pollination. This practice of artificial pollination is depicted on ancient Egyptian monuments.

Papyrus

"Can papyrus grow where there is no marsh? Can reeds flourish where there is no water?"

The Hebrew word 'gomeh' must have been a swamp plant and in view of the different uses mentioned, it could not have been anything other than *Cyperus papyrus*. The word 'gemi', in post-biblical literature, is probably derived from 'gomeh' and refers to papyrus — because of its impressive appearance and its multiple uses in making boxes, mats, ropes, boats, and especially paper. Similar uses of papyrus is also mentioned in excerpts of Bible: "And when she could hide him no longer she took for him a basket made of *bulrushes*, and daubed it with bitumen and pitch". 'Bulrushes' is the common name for *Cyperus papyrus* (papyrus).

Barrels, shoes, huts and clothing for the poor were also made from papyrus (Zohary 1982).



FIG. 3.2

Cyperus papyrus, the "papyrus" of the Egyptians, in marshy area in a conservatory.

As early as the 18th Dynasty (2,400 BC), the Egyptians used papyrus to manufacture paper from the long and thick stalks, green outside and with a broad white pith. The stalks were slit and the pith was cut into long strips, glued together with a special adhesive, and then pressed and dried.

Israel is the northern limit of the distribution of papyrus. It is a tropical plant which occurs on some coastal river-banks. Its main distribution center is in the upper Jordan Valley.

Cyperus papyrus (Figs. 3.2,3.3A) is a tropical perennial plant of the Sedge family (Cyperaceae). It has a thick, horizontal rootstock that gives rise to numerous aerial stems and roots that penetrate



FIG. 3.3 A,B

A *Cyperus papyrus*, used for writing by early Egyptians.
B *Betula utilis*, the bark used for same purpose in ancient India.

the muddy ground. The triangular stems may be up to 10 cm in diameter and 2 to 6 m in height, usually with a rosette of leaves at the base and terminate in a large umbel-like inflorescence with a large number of spikelets.

In India, many ancient manuscripts were likewise written on the bark of a tree known as 'Bhojpatra' or *Betula utilis* (Fig. 3.3B). The plant grows exclusively at higher altitudes of the Western Himalayas. The smooth shining white, yellowish-or pinkish- white layers of the bark peel off naturally. This papery bark has been used as the paper to write upon just as the palm leaves (*Borassus flabellifer*, see Chapter 7, pp 91, 92) have been used in some other parts of this country.

Crown of Thorns

"Then the soldiers of the Governor took Jesus into the praetorium, and they gathered the whole battalion before him. And they stripped him and put a scarlet robe upon him and plaiting a crown of thorns they put it on his head and put a reed in his right hand. And kneeling before him they mocked him saying: "Hail, King of the Jews!"

More than seventy species of spiny plants grow among the flora of Israel, and more than twenty are mentioned in the Scripture. In any version of the Bible, none of the thorn names is reliably translated. The use of 'thorn' or 'thistle' is, therefore, for the entire group of spiny plants.

The most reasonable suggestion to identify the "Crown of Thorns" on Jesus is as *Ziziphus spina-christi*. These plants are fairly common in the northern part of Israel. Of the dozen spiny species from Jerusalem, the thorny burnet or *Sarcopoterium spinosum* (a dwarf shrub) is very common and can be regarded more reasonably as the plant in question. However, the Christian tradition looks upon *Ziziphus* as the "Crown of Thorns", and for those who insist upon

having a Christ-thorn growing in Jerusalem, there are still a few trees available on the eastern slopes of Mount Moriah.

It is an evergreen tree up to 10 m tall, with a large, oval, intricately branched crown. The leaves are ovate, prominently 3-5 nerved with a dentate margin and two spiny stipules, one is hook-like and the other straight. The flowers are yellowish-green, and fruits yellow, fleshy, edible drupes. The plant is fairly common in Samaria and in southern Israel, and also very common in the upper Jordan Valley.

'Thorny Burnet' (*Sarcopoterium spinosum*) is a characteristic plant of the Mediterranean landscape. Since it abounds in Jerusalem, it might have been the plant from whose spiny branches the Roman soldiers plaited the "Crown of Thorns" for Jesus.



The Cups That Cheer

THERE are three leading beverages: tea, coffee, and cocoa. These plants grow in tropical and subtropical lands, have achieved great popularity, and occupy a prominent place in the world of commerce.

Tea

Tea has the distinction of being the world's principal and cheapest beverage. Tea consists of the dried leaves of a small evergreen shrub, native to south-east Asia, and was consumed, first, for its medicinal properties. The Chinese recognized the attractiveness of its flavour and its stimulant value, and their poets were singing (thirteen to fourteen centuries ago) its praises as a beverage. It was not until almost a thousand years later that the habit of tea-drinking reached Europe from China, at first a luxury in which only the extremely wealthy could indulge.

The first Tea House was inaugurated in Exchange Alley, London, in 1657. Soon, tea-drinking became popular as a non-alcoholic drink. Even today England is the largest nation in the west to consume tea.

The English emigrants to North America introduced the habit to the local inhabitants. The heavy taxation that was imposed for tea

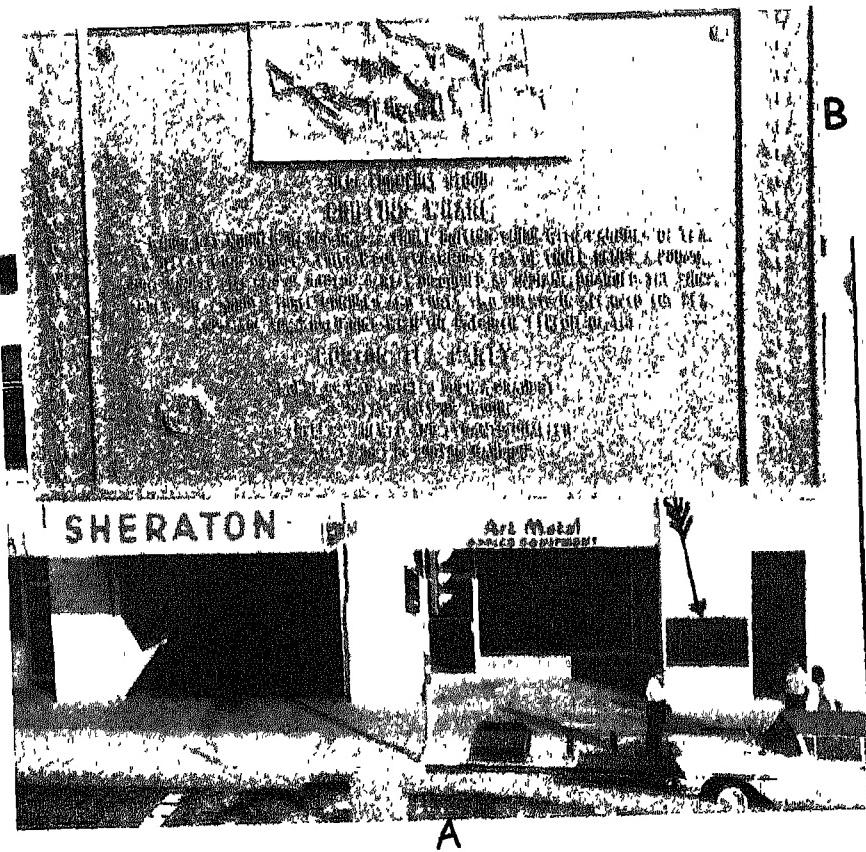


FIG 4.1 A, B

Boston Tea Party A The building where the plaque has been put up.
B Plaque reveals the facts that led to Boston Tea Party.

import by the then government led to a revolt by the settlers. They were so enraged as to seize the newly-arrived shipment of 342 chests of tea on December 16, 1773, and threw the chests into the Boston harbour. The incident, known popularly as the 'Boston Tea Party' (Fig. 4.1A,B) was the starting point for the war of independence of America.

Tea consists of dried leaves and stem tips of a plant called *Thea sinensis* (Fig. 4.2A,B) belonging to the family Theaceae. The word tea comes from 'te' used in one of the Chinese dialects, in place of the more universal 'cha'.

The origin of the use of tea is depicted in many folklores of different south-east Asian countries. In Japanese mythology, a Buddhist saint in China was meditating for nine years seated before a wall. During one of his meditations he fell asleep. Upon awakening, he was so distressed that he cut off his eyelids to assure any recurrence of such a sinful act. When the severed eyelids fell to the ground, they rooted and grew as tea plants. An infusion of the leaves of this plant could keep sleep at bay.

According to a Chinese legend, the credit of introducing the use of tea goes to Emperor Shen Nung in 2737 BC. He liked the drink served to him, in which some tea leaves had fallen accidentally. An ancient Chinese dictionary, *Erh Ya* of about 350 BC, also reports about tea. In the *Ch'a Ching*, a handbook of tea, written by Lu Yu about 780 AD, the product is described as a cake made from leaves, that had been steamed, crushed and moulded. The cake was fired and toasted or shredded, and then steeped in salted boiling water.

Thea is native of south-western China and north-eastern India. Of the two main varieties, the Assam plant, which may well be the original, was discovered growing wild in north-east India, and was



FIG. 4.2 A,B

Tea, *Thea sinensis* A Flowering twig. B Bud and the two upper leaves are collected and 'cured' as tea.

adopted for large-scale cultivation by the British planters. It is taller, and bears larger leaves than the Chinese variety. If untended, it will grow into a fair-sized tree but on plantations it is pruned every spring to dimensions of a bush about 3 to 5 ft in height.

The British East India Company, world's greatest tea monopolist at one time, played a major role in the introduction of Chinese and Indian teas into England and Colonial America. The author of the book entitled: *Three Year's Wanderings in the Northern Provinces of China*, Robert Fortune sailed to China as an employee of the East India Company with a commission to procure seeds and plants of the best tea varieties and transfer them to India. Tea-plantations were already established in India, from plants procured from Canton, but the varieties were rather poor. Robert Fortune took all the trouble of both, the unknown country and not-so-cooperative Chinese, and

reached the celebrated hill of Sung-lo-shan, where the green-tea shrub was supposed to have been first discovered. He undertook all these dangerous journeys posing as a Chinese. He went to black-tea districts also for collection of seeds. In India, however, the mutiny of 1857 made the East India Company wind up. Therefore, the Company's plantations were neglected and eventually Chinese teas were superseded by Assam tea.

In European literature, tea was first mentioned as 'Chai Catai' (tea of China) by the venetian writer Gian Battista in his book *Navigationi e Viaggi* (Voyages and Travels). Tea, when first reached England, was used in an entirely different way. The decoction of leaves was discarded and the boiled leaves were put between the buttered toasts and eaten.

Tea plants thrive from sea level to an elevation of 7,000 ft, the higher the elevation, better is the crop. Tea is widely cultivated on the hill slopes of tropical and subtropical areas which receive heavy monsoon rains, experience warm wet climate, and have well-drained fertile clay-loamy soil. Major part of the world's commercial crop is produced in north-east India and Sri Lanka.

Commercial tea is categorized into three types: Black, Green and Oolong. China, Japan, and Formosa produce the more delicately-flavoured China tea which may be black or green. Preparation of green tea, which is considered unpalatable by the habitual drinker of black tea, needs no fermentation. In Formosa a semi-fermented tea known as Oolong is produced. Of these the black tea is in great demand. Indian Darjeeling Tea is the best variety of black tea.

Tea contains 2-5% theine (an alkaloid) together with a volatile oil and considerable tannin (13-18%). The stimulating effect comes from the infusion of alkaloid and oil in water.

Coffee

The world is indebted to Africa for the beverage coffee (*Coffea arabica*; Fig. 4.3A,B), a native of the highlands of southern Abyssinia. Its name is derived from the district of *Kaffa*, where it was discovered. From Abyssinia, in the 15th century, it was transferred across the Red Sea to Arabia, and thence to Europe.

Although nothing much is known about its ancient history, the use of coffee was known to the Ethiopians for a long time. A story narrated among the Arabs is that coffee was 'discovered' as a drink by a Mohammedan priest who had trouble in keeping his subordinates awake during evening prayers. He learnt from a goatherd by the name of Kaldi, that his domestic goats always appeared to suffer from nocturnal restlessness after eating the berries of a certain shrub. The goatherd himself also tried these berries and became highly excited over the resulting exhilaration and wakefulness. The priest experimented on his fellow priests and, at last, succeeded with an infusion made from roasted and ground seeds.

The Arabian merchants very cleverly added coffee to spices and other luxuries of the Orient for its universal popularization. They themselves became so interested that the first public Coffee Houses or 'Kahveh Khana' were opened in Mecca and Medina. By the end of the 16th century, many Coffee Houses with fashionable names like 'Cafe of the Roses' and 'Cafe of the Gates of Salvation' were a common sight in the eastern Mediterranean. The first Coffee House in England was opened in 1650 in the university town of Oxford, and it was soon followed by others in London. The Coffee Houses rapidly became an integral part of the daily life of the better-educated Londoner, who at nominal cost could gather with other patrons for relaxation, intellectual discussion, and refreshment. The number of Coffee

Houses kept on increasing, till every rank and profession and every kind of religious and political opinion had its own headquarters.

The best known Coffee Houses came up during the Puritan Commonwealth (1649-1659) and were excellent political meeting places. It was in 'Miles Coffee House' that the first ballot box was introduced and used. When King Charles II came to power, the importance of the Coffee Houses as a public meeting place increased. Parliament was rarely called and there was hardly any contact between the government and the people; press as well as informative books and other publications were controlled. Obviously, the Coffee Houses became the news centres and handwritten posters on the walls kept the public informed. In 1675 the King tried to suppress the Coffee Houses but, in the face of the public outcry, he had to withdraw his order.

At first coffee was used as a food. The powdered seeds were made



FIG. 4.3 A, B

Coffee, *Coffea arabica*, A Fruits borne on stem. B Coffee beans.

into balls with butter, and were carried during desert journeys to provide both stimulant and food.

The cultivation of coffee bushes was started in the Asiatic tropics after the Dutch introduced it into Sri Lanka and Java, in the 17th century. In the New World too, it was introduced by the Dutch. The ultimate source of the trees in most present-day coffee plantations in the New world was a single tree from Amsterdam. A descendant of this tree provided the seeds for the French introduction of coffee into the Caribbean Island of Martinique in 1720, from the 'Jardin des Plantes' (Botanical Garden) in Paris. Coffee is now produced all round the world between the Tropics of Capricorn and Cancer. Till about 1870 AD, the British drank too much coffee. However, when the 'leaf spot' disease (caused by the fungus *Hemileia vastatrix*) wiped out the coffee plantations of the British empire in Sri Lanka in particular, they switched on largely to tea. Recently, diseases and frost have caused several problems to the coffee plantations of South America; as a result the price of coffee has shot up.

The seeds or 'coffee beans' (Fig 4.3 B) are roasted to impart a characteristic aroma, flavour and colour. The roasted beans contain 0.75-1.5% caffeine, the stimulating principle, and a volatile oil that gives the flavour and aroma. Glucose, dextrin, proteins and a fatty oil are also present. Besides drinking, ground coffee mixed with sugar is eaten in Turkey. In Sumatra the leaves make a good-flavoured beverage. Coffee extract, soluble coffee, and decaffeinated coffee are now commonly available.

Cocoa

The third beverage-producing plant is the cocoa tree — an evergreen plant *Theobroma cacao* of the family Sterculiaceae. The plant is native to the forests of tropical Central and South America. The Mayas and

Aztecs cultivated it, and it was encountered in 1519 by Cortés and Bernal Diaz, who visited the Aztec Emperor, Montezuma II, in his palace in today's Mexico City. The guests were served chocolate, a highly luxurious drink, reserved for special occasions and guests. Even the natives were well aware of the value of cocoa beans and used them as a medium of exchange. The Mayas and the Aztecs made chocolate by pounding cocoa seeds alongwith maize grains and then boiling the powder with water, adding capsicum peppers. The Spaniards substituted capsicum with sugar but they still found it necessary to add maize flour to counteract the unpalatability due to high fat content of the cocoa beans. The Aztec name for the beverage 'Chocolatl', was changed to 'Chocolate' by the Spaniards so that it could be easily pronounced by the Europeans.

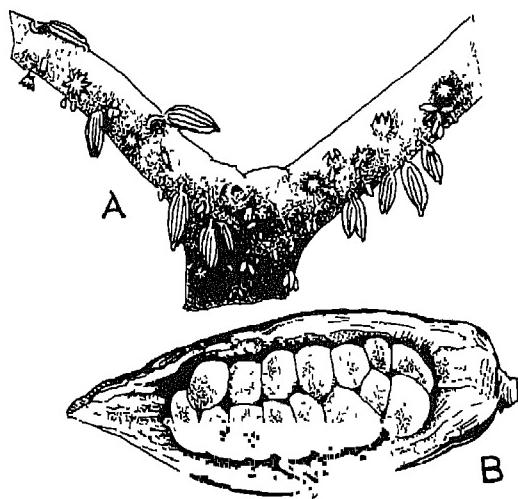


FIG. 4.4 A, B

Cocoa, *Theobroma cacao*.

A Fruits borne on stem. B Fruit cut open to show the seeds.

At first cocoa beans were exported to Spain only from Central America, and after 1525 also from Trinidad and Venezuela till their monopoly was broken by the Dutch.

The cocoa or chocolate became better known to the European countries at the end of the 16th century. By early 19th century, C.J. Houten of Holland developed the process of removing excess fat from the cocoa beans to make drinking-chocolate a much more palatable drink.

The Dutch introduced cocoa to the Island of São Tomé in the Gulf of Guinea, from where a labourer introduced the cocoa plant into West Africa, in 1878 or 1879. And, gradually, West African countries became the world's leading producer of cocoa beans.

Theobroma or 'food of the Gods' is of tropical origin and cannot be grown in areas with marked seasonal fall of temperature and humidity. *Theobroma* requires a warm moist climate, high temperature, and abundant rainfall throughout the year, and a deep and well-drained soil.

The small cocoa tree bears 8-12 inches long dark-red leaves which hang down limply from the branch tips when they first open. This habit is probably an adaptation to the heavy rains. Compared to the leaves, the half-inch long flowers are tiny, arising from dormant buds on old stems: a feature called 'cauliflory'. Of the many flowers, only a few develop into fruits (Fig. 4.4A), a brown or orange pod, 4-10 inches long. Each pod contains 5 rows of 8 to 10 bean-sized seeds embedded in a pink pulp (Fig. 4.4B). The pulp is sweet and faintly acidic to first taste but bitter and astringent on biting. The pods are opened, the seeds and pulp scooped out and left to ferment for a few days. During this period the seeds acquire their characteristic aroma.

The cocoa bean is regarded as one of the ideal food-stuff, because

it contains carbohydrates, albuminoids and minerals. It provides solid chocolate, chocolate drink, and other products. The fatty oils (30-50%) are used for making cocoa butter. Cocoa butter is an important by-product and is widely used in the preparation of cosmetics. Cocoa shells are used as fertilizer and cattle feed. The seeds also contain less than 1 per cent theobromine (an alkaliiod) and traces of caffeine.



Insect Diet for Plants

WITH the aid of chlorophyll and in the presence of sunlight, the plants 'make' their own food from simple materials like carbon dioxide and water. A small number of plants inhabit bogs where supplies of nitrogen are often deficient — and are an exception to the general rule. These plants have adopted a partial insect diet; but they still contain chlorophyll and can prepare some 'food' for their own nutrition.

Sundew

A good example of such 'insect-devouring' plants is the sundew, scientifically known as *Drosera* (Fig. 5.1A). This is a pretty little bog plant with reddish leaves covered with glistening sticky tentacles (Fig 5.1B). If an insect comes in contact with the leaf, it is held fast. Quickly the tentacles bend and cover the insect. The secretion from the tentacles (similar to our gastric juice) contains protein-digesting ferments which partly digest the prey. The resultant liquid is absorbed by the leaf-tissues. The sundew can be made to digest fragments of meat or egg-white, but it will not react to bits of glass, cinders or paper.

Drosera rotundifolia has a rosette of spreading, long-stalked round

leaves about half-an-inch in diameter. Their upper surface is covered with long hair-like tentacles. These bear crimson glands at the tip which secrete the so-called 'sundew', a sweet-smelling, sticky, glistening substance that attracts and holds insects as large as a housefly.

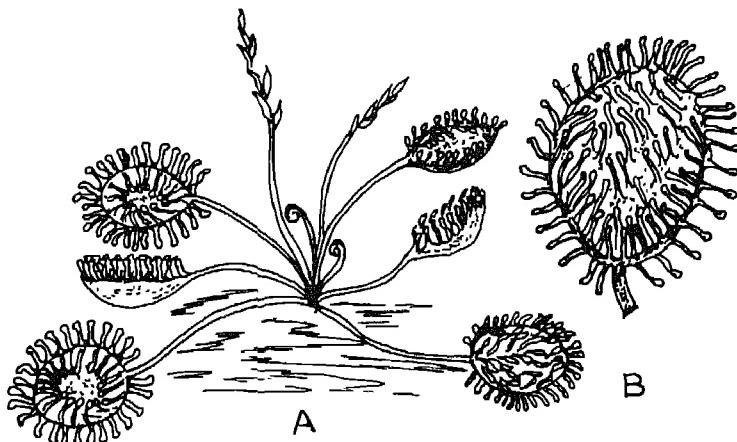


FIG. 5.1 A, B

Sundew, *Drosera burmanni*, leaves studded with glandular hairs.

Drosera anglica, the 'great sundew', has 4-inch diameter leaves. *D. inter-media* or 'long-leaved sundew' has 1½-inch obovate leaves. These species of *Drosera* are hypersensitive to slight traces of salt and therefore cannot be cultivated easily. Popular green-house ornamentals are South African *D. capensis* with red flowers, and *D. binata* and *D. spathulata* of Australia with white flowers. Both the species look striking when the glittering sundew droplets catch the sun.

Butterwort

The butterwort (*Pinguicula*; Fig. 5.2) with beautiful mauve flowers also

grows in bogs. The sticky leaves are yellowish-green with incurved edges. Tiny glands on the upper surface secrete a ferment which



FIG. 5.2

Butterwort, *Pinguicula*, with mauve flowers, grows in boggy areas.

digests any insect that is caught. A leaf of this plant put into the milk turns it into curds and whey, just as by the rennet from a cow's stomach.

Venus fly-trap

Darwin designated 'Venus fly-trap' as 'the most wonderful plant in the world'. The distal end of the leaves of this plant differentiate as

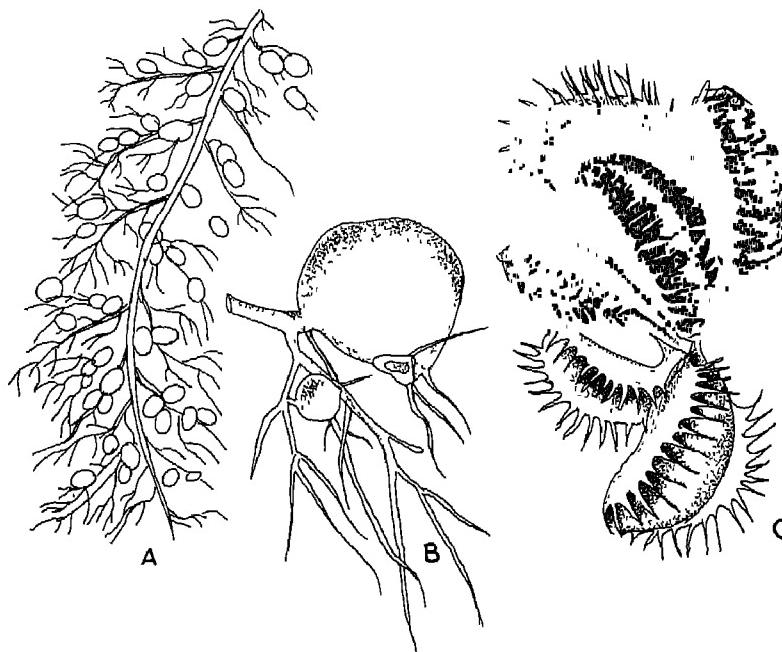


FIG. 5.3 A - C

A Bladderwort *Utricularia*, branch with highly dissected leaves and bladders.
B Leaf with bladder, note the trap-door. C Venus fly-trap, *Dionaea muscipula*, leaves with sensitive stiff hairs.

traps. The marginal 'cilia' of the leaves interlock when the leaf is stimulated by the presence of an insect.

Botanically, it is known as *Dionaea muscipula* (Fig. 5.3 C)

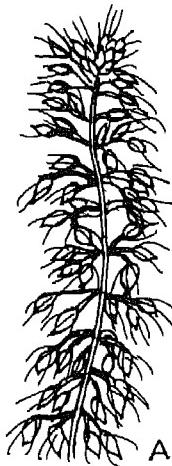
Aldrovanda

A rootless floating aquatic, *Aldrovanda* (Fig. 5.4A,B) is one of the rare and threatened plants. Although South European in origin, it is now confined only to a few saline ponds near Calcutta in India. With the destruction of these wetlands, these plants are slowly disappearing. The leaves of this plant are somewhat like those of *Utricularia* (Fig 5.3 A,B).

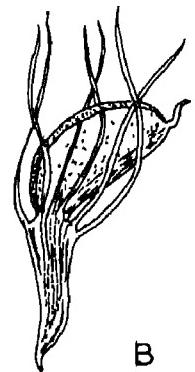
Trapdoors

Of a very different type is the bladderwort (*Utricularia*, Fig. 5.3 A,B). The majority of *Utricularia* grow in pools of water, foot-tracks on moors, and in the little collections of water between clumps of reeds in peat bogs. And these places are also the haunts of the little creatures that fall into the traps. *Utricularias* are aquatic, submerged, rootless plants with finely-dissected leaves bearing insect-catching bladders. The opening of the bladder is very interesting. It is provided with a valve which opens inwards only, in response to an external stimulus. To start with there is no water inside a bladder, and its walls appear collapsed. When the tiny swimming animalcule touches the sensitive 'bristles' around the entry, the door flies open, and the small animalcule is sucked in along with the water. The door snaps back, and as it cannot be pushed open from within, the prey is secured and later digested by digestive juices secreted from the glandular hairs lining the inner wall of the bladder.

One species, *U. nelumbifolia*, grows in the mountains of Brazil in the rain-filled receptacles of *Tillandsia* plants. *Tillandsia*, 'Spanish



A



B

FIG. 5.4 A, B
Aldrovanda vesiculosa, endangered species. A Branch with dissected leaves and bladders. B. leaf with a bladder

Moss' (allied to pine-apple), has rosettes of concave leaves. The latter rest one upon the other so as to form a niche or cavity in front of each leaf, filled with rain-water (like a cistern). The animalcules swimming in water fall into the leafy traps. Another remarkable feature is that long runners are thrown out from its stems and grow across in wide arches, from one cistern to a neighbouring one.

Colourful Pitchers

Despite their extra food supply, the insectivorous plants of the temperate countries are far from conspicuous. Much more striking are some tropical forms like the pitcher plants.

Nepenthes grows in the tropical rain forest areas of the Old World. These are shrubby plants, often climbers. The leaves have four distinct zones: (a) an expanded or winged petiole, (b) followed by a constricted often coiled or

tendriller zone, (c) a pendant, highly coloured, cylinder or flask-shaped brightly-coloured pitcher with a recurved rim, (d) terminated by a variously-margined lid (Fig. 5.5 A,B). Nectar is produced round the edge of the rim. Insects are attracted by both, the colourful pitcher and the glistening nectar. The insects come to sip the nectar. As soon as they move in, they find the surface very slippery and just slip in. Once inside, they cannot come out because of the downward-facing hairs on the inner wall of the pitcher. At its bottom, there is a copious secretion of digestive fluid into which the insects get drowned, and the plant absorbs the products of their decay. The pitcher of some forms may be as much as eighteen inches long, with liquid sufficient to drown a small bird.

Sir Hugh Low collected *Nepenthes hookeriana* from the dense

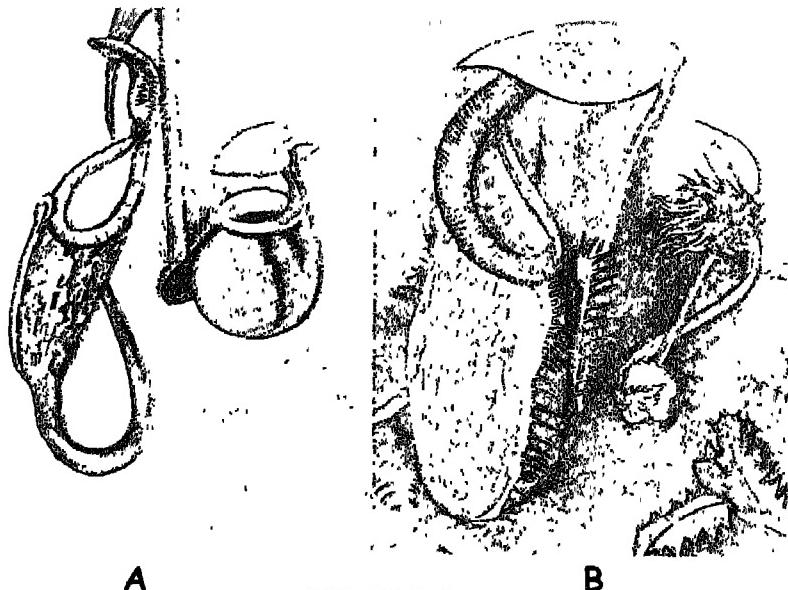


FIG. 5.5 A, B
Nepenthes ampullaria, pitchers

forests of Borneo and commented: "the great urned *Nepenthes*, never before seen or imagined in dreams".

Sarracenia (Fig 5.6) is yet another such insectivorous plant from the USA and northern South America. These plants usually grow in water-logged soil that lacks soluble nitrate. The radical tubular leaves are provided with specialized glands and hairs which help in entrapping insects and other small organisms which are ultimately digested by the plant.

Interesting though they are, the flowering plants which prey on animals are but an insignificant fraction of the whole plant kingdom. One should be glad that there has been no such development as the imaginary orchid of Mr H.G.Well's story, whose aerial roots fastened (or attached) themselves like leeches to their grower and sucked his



FIG. 5.6
Sarracenia, pitcher plants.

blood! Nor are they like the colourful trees, fruits and flowers of the 'Dream Island' of Mr Satyajit Ray, which would suck the intelligence out from human brain and leave them child-like !



They Like it Hot and Spicy

MAN has been using the spices to flavour his food since prehistoric times, particularly so in the tropics where the monotonous nature of the staple diet could be changed by adding spices. Spices also help in disguising the unpleasant flavour of meat that is not fresh, another important feature in the tropics before the advent of refrigeration. In addition, consumption of many spices increases the rate of perspiration, which brings about cooling of the body.

Spices, at one time, had been so important as to have been used as currency. During the 15th and 16th centuries, much of the exploration of the world was in search of the spices. The rediscovery of the American continent by Columbus was inspired by the search for a shorter route for the Indian spices—particularly the pepper. The spice trade of the East is closely linked with the history of civilization itself.

Spices are consumed more for their taste and aromatic nature and less so for their food value. The spices do not form the energy source in our food comparable to rice and wheat, but are a good source of vitamins and minerals in addition to the flavouring agents. The

flavour or aroma is due to essential oils. These are organic substances of varied composition with relatively smaller molecules, and therefore volatile. More often than not, the essential oils belong to the chemical group of hydrocarbons called 'terpenes' and can be extracted by solvents.

If we could look back into the past, we could probably see the Ishmaelite traders leading camel caravans burdened with bales of spices towards Egypt; children of Israel preparing the anointing oil from the chef of all spices for use in the tabernacle; ancient Egyptians pounding spices in stone mortars to embalm their dead for mummification; Egyptian and Babylonian priests crushing spices to obtain fragrant oils for offering in holy rituals; weary Egyptian labourers engaged in building the Great Pyramids munching garlic to get energy; caravan of camels carrying the spice gifts of the Queen of Sheba to the wise King Solomon; spices growing in the magnificent gardens of Babylon; busy spice traders in the market place of that great city; large quantities of spices piled high on rafts moving along the Euphrates and Tigris rivers; spice caravans moving across the hot sandy deserts from Arabia to different places in the Middle East, and the Arabs jealously guarding the secret of their spice trade with India.

Many other visions could appear — ancient physicians applying balms made from spices to the wounds of warriors; Egyptian ladies perfuming their bodies with the fragrant fumes of cinnamon; Persian mothers planting sweet basil on the graves of their departed sons; Maidens keeping sprigs of anise by the side of their pillows to keep away bad dreams, and many more.

The Vedas, the Bible and the Quran are all rich with references to Indian spices, directly or indirectly. The earliest mention of spices

in India is in the Rig Veda (6,000 BC). Horse-radish (*Armoracia rusticana*), a close relative of *Brassica* and *Raphanus* (their fleshy cylindrical roots are used for flavouring food products), is mentioned in the Rig Veda; pepper (*Piper nigrum*) in the Yajur Veda, and turmeric (*Curcuma longa*) in the Atharva Veda. Manu, the first law-maker of the Aryans (4,000 BC), was aware of the origin, growth and use of garlic (*Allium sativum*). He also said that offering saffron (*Crocus sativus*) is the highest form of hospitality to a Brahmin guest (Ummer 1991).

Spices are also mentioned in the great epic story of the Ramayana. The sage Valmiki refers to a food in which meat, rice, vegetables and spices are cooked together — something like 'meat-pulao'. Plants like turmeric (*Curcuma longa*), basil (*Ocimum basilicum*), and saffron (*Crocus sativus*) were apparently in use.

The first written record of the use of spices goes back to about 2,600 to 2,100 BC, in Egypt. The famous Ebers' papyrus by Georg Ebers' (1874 AD) reveals a great deal of information on ancient spices and herbs obtained from a medical treatise dated 1550 BC. The Egyptians knew and used about one-third of the plants in the modern pharmacopoeia. Most of their medicines were of plant origin. Cardamom (*Elettaria cardamomum*), garlic (*Allium sativum*), thyme (*Thymus vulgaris*), Juniper (*Juniperus communis*), lotus (*Nelumbo nucifera*), linseed (*Linum usitatissimum*), fennel (*Foeniculum vulgare*), poppy (*Papaver somniferum*) are some of them. The Cretean civilization of 2,000 BC also had influence on Egyptian medicine and they obtained the plants of saffron (*Crocus sativus*), sage (*Salvia officinalis*), and henna (*Lawsonia inermis*) from Crete.

During the period 2,000 BC and 3,000 BC, the Assyrians and Babylonians were already trading with India in cardamom, pepper, and cassia (*Cinnamomum tamala*). Ebers' papyrus (1550 BC) mentions

about cardamom and pepper. Around 1,000 BC, Queen Hatshepsuth of Egypt sent a fleet of five ships to the Malabar coast (India) to collect spices. Maidens of today use too many different types of toileteries to keep themselves beautiful. But, they would envy the Greek beauties of yesteryears if they knew their secret of keeping themselves so lovely. The young ladies of the well-to-do families used to envelope their bodies with the dense smoke produced by burning cardamom and sandalwood to stay beautiful (Oh, what a waste in today's context). The use of smoke and oil of several spices — during prayers at the shrines built by Moses — is mentioned in the Bible.

The Greek physician Dioscorides (40-90AD) described the medicinal properties of various spices like cardamom, pepper, ginger (*Zingiber officinale*) and turmeric in his *Materia Medica*. The name *Zingiber* (Greek) had evolved from the Dravidian name 'inchiver' meaning ginger-root, *Cardamom* is derived from the Sanskrit name 'Kardamum'. In Sanskrit the pepper has been catagorised as 'Yavanapriya', i.e. beloved of the Greeks. No doubt, pepper was dear to the palate of every Greek. An ancient Tamil poet (name unknown) has written:

"The thriving town of Muchiri
(today's Kodungallur near Cochin)
Where the beautiful great ships of the
Yavanas (Greek), bringing gold,
Come splashing the white foam
On the waters of the periyar
And return laden with pepper".
Over a long period of time the Arabian traders had a monopoly in

Indian spices as they acted as intermediaries between Indian spice-lands and the European markets. They lived in the south-western part of the peninsular Arabia and were known as 'Sabaeans' (from the city of Saba). Saba was a commercially flourishing township long before the birth of Jesus Christ and Prophet Mohammed. Aden and Mocha were the two important ports for the entry of many interesting merchandise from India, such as pepper, myrrh, fragrant gums and resins, saffron and sweet rush in addition to ivory, ebony, teak, silk and sandalwood. The Arabians not only guarded the secret of their source of supply of these items, but also misinformed and misguided others. Even Herodotus (485-482 BC), the famous Historian, referred to India as a 'Persian Province'. Many others identified Arabia as the 'aromatic country' and 'spice-producing' land. Even Shakespeare, the famous English poet, made this mistake:

"Will all the perfumes of Arabia
Sweeten this little hand, oh, oh"

(Macbeth)

This monopoly remained till the 1st Century AD.

Very soon, the Egyptians fought against the Arabians for control of the sea-route to India. Afterwards Rome occupied Egypt but the threat to the Arabs continued. Around 40 AD the Greek mariner, Hippalus, acquired the knowledge of the monsoon winds, took a short-cut to India, and returned to Alexandria with a large quantity of Indian spices. The early Roman settlements at Muziris (Kodungallur near Cochin) are mentioned in ancient literature and coins of the Roman period have been discovered in large quantities in nearby areas. The Romans too traded in spices like cinnamon, pepper and ginger as these items fetched a very high price back home. Pepper was sold for as high a price as 15 denarii a pound (lb). Hoards of Roman gold

coins dating back from the reign of Nero, Hadrian, Tiberius, and Trajan (14 -138 AD) have been discovered in Kerala.

The dominance of the monsoon to determine the course of the spice-trade remained till the time when the steam-ships came in the picture to carry on the business.

The heavy exchange of money on pepper by Rome brought its own doom. Pliny the Elder (23-79 AD) observed: "It is surprising that the use of pepper has come so much in fashion. Commodities as a rule attract us by their appearance or utility: but the only quality of pepper is its pungency, and yet it is for this very undesirable element that we import it in very large quantities....."

However, hay days do not remain forever and the fall of Roman Empire was followed by stoppage of her trade with India. It is said that when Alaric the Goth (370-410 AD) captured Rome, he demanded as his tribute, 5000 lbs of gold, 3000 lbs of pepper, and 30,000 lbs of silver. Attila (406-453 AD), the king of Huns and Scourge of God, as he was called, demanded, 3,000 lbs of pepper as part ransom for the city of Rome. Once again the Arabians became the ruler of sea and the spice-trade passed into their hands. The Arab traders settled in areas near the Malabar coast and their trade in Indian spices touched a new horizon. With the merchandise from Calicut, Kodungallur and Quillon, their ships were now bound for China via Ceylon (Sri Lanka) and the Malaya Archipelago.

In the meantime, China was also getting interested in spice-trade with India. Very early in the history, Indian seasonings and spices like nutmeg (*Myristica fragrans*) and clove (*Syzygium aromaticum*) from the Spice Islands (the Moluccas) had been introduced into China. It is said that in the 3rd Century BC, it was customary for a courtier to hold a clove in his mouth while addressing the Emperor. This

practice kept their breath sweetened in royal presence.

During the 1st century AD, a royal messenger of the then King of China came to Kodungallur asking for spices. Sulaiman (851 AD), an Arab merchant, records that Kerala and China had excellent trade relations. Even Marco Polo wrote: "The merchants from Manzi (South China) and from Arabian and from Levant come thither with their ships and their merchandise and make great profits both by what they import and what they export."

The monopoly of the Arabs in spice-trade was smashed for good when Vasco da Gama arrived at Calicut, i.e. when the sea-route to the East was discovered by the sea-faring people of the West. The Portuguese collected spices and other products from Cannanore, Calicut, Cochin and Quillon. They were rather ruthless in their methods, sometimes resorting to absolute vandalism. Even the Portuguese could not establish monopoly over the spice-trade as the more powerful Dutch were already showing up. The Portuguese, however, did some good deeds also such as evolving scientific scheme for cultivation of pepper and cardamom, and sent the commodities directly to the European markets. Dutch, of course, could not remain in the arena for a long time as the French and the British were already advancing. But they too made some contributions. The priceless work on Indian medicinal herbs — *Hortus Malabaricus* — was prepared by a team of hardworking Ayurvedic Vaidas (doctors) under the supervision of Admiral Van Reed. This work was published in twelve volumes in Amsterdam between 1678 and 1703 AD.

Ruthless and inhuman in their relations with the native inhabitants, the Dutch were worse than the Portuguese. Wealth poured into their small country as it had done earlier into Portugal. Large and beautiful buildings were erected, fashionably-dressed men

and women were seen everywhere, and people began to live in idleness. During this period, a large number of painters, musicians, scientists and poets came up with their talents. So, many countries one after the other flourished under the Midas touch of spices.

In 1615 AD the British landed in Calicut with the dream of monopolising the spice-trade. They exported pepper to England for the first time in 1636 AD. And, after this there was no looking back. Over the years, they gradually colonised India and other south-east Asian countries, and established the 'East India Company'. The British became firmly established on Indian soil. They started the organized cultivation of spices in specially developed plantations. Such plantations were established in north Malabar for cultivation of pepper, cinnamon, nutmeg and coffee.

Colonel Robert Kyd was an officer in the East India Company's army and also the founder of Royal (now Indian) Botanic Garden at Hoogly (Kolkata). He suggested that the garden could also be used to make trial plantings of the spice plants in which they were trading. It was an unsuccessful attempt as the garden was devastated by a cyclone shortly after the work was started.

Today, the role of spices may not be that important but it cannot be denied that they have played a very crucial role in the exploration of the world, economic warfare, annexation of territories, and development of human civilization. We can realise the pivotal role played by the spices of India in the development of modern civilization. At a time when the Western world knew nothing of sugar, tea, coffee, potatoes, citrus fruits, tobacco, pepper, or cinnamon, it was the oriental spices which made life worth -living. It was the spices that helped to change the monotony of taste, and to mask the unpleasant odours by its fragrant aroma. Both politically and economically, they were useful as well as indispensable. Even during the 13th and 14th

centuries, pepper was held in such regard that landlords asked their tenants to pay rent in pepper. Kings presented pepper to each other and it was received with keenness and enthusiasm. Even people wrote wills passing on the peppers to their sons and grandsons! Custom duties, taxes, court fines were all paid in pepper. In addition to pepper, ginger and cardamom were also important spices. When Henry II of the Holy Roman Empire went to Rome, the streets were fumigated with clove. One pound of ginger could buy a sheep. Cardamom, cinnamon and many others were used in ointments and medicines.

A brief account of some spices—capsicum, pepper, clove, nutmeg, saffron, cardamom, cinnamon, fennel, and cumin follows.

Peppers

Several unrelated plants are known under the name 'peppers'. The black and white peppers belong to the genus *Piper*, also known as true peppers (*Piper nigrum*). Capsicum peppers or chilli, on the other hand, are species of *Capsicum* — a native of the New World.

Capsicum

On reaching the New world, Columbus was under the impression that he had reached the Far East, and although he did not come across any true pepper, he did meet the one that rivaled them. In 1493 Peter Martyr, a historian reported that the New World peppers were more pungent than those of Caucasus, i.e. the true peppers.

The *Capsicum* fruits are very pungent and that is their special claim to fame. According to some writers of the 16th Century, smoke from burning peppers was used by the South American Indians in warfare with Spanish invaders. A woman is said to have repelled a would-be thief by throwing pepper-sauce in his eyes. In the dispute

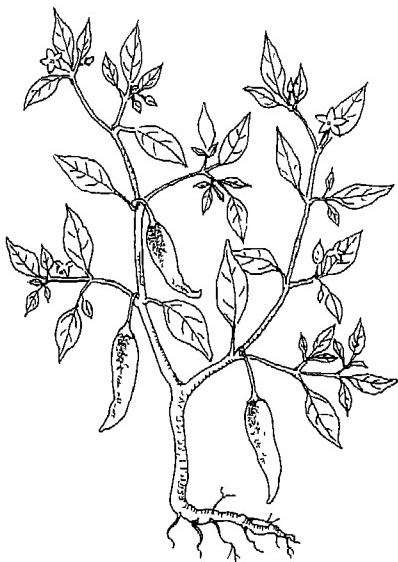


FIG. 6.1

Chilli pepper, *Capsicum annuum*, fruiting plant

between the Government and the Buddhists in south Vietnam in 1963, Buddhist monks carried with them spray-guns containing a mixture of lemon juice, curry powder and red chilli powder. It was, however, not reported whether the guns were used or not. Another story is that in earlier days at square dances in America, it was considered a good humour to sprinkle chilli powder on the dance floor. This would bring tears in the eyes of the dancers after a few steps. Among the Mayans of Mexico, if a young maiden was caught glancing at a man, her mother rubbed chilli pepper in her eyes as a punishment.

Among the Caribb Indians of Lesser Antilles, pepper was rubbed into wounds of boys during some rituals that prepared them to be warriors (Heiser 1969).

Chillis are native of the American tropics and subtropics and the West Indies. Fragments of pepper have been recovered from Mexican caves dating about 7,000 BC and from ancient burial sites of Peru.

The botanical name *Capsicum* is derived from the Latin word 'capsā'-referring to the 'box'-like shape of some of the fruits or Greek 'Kapto' meaning 'to bite' -referring to its pungency. Much diversity is known in the form and size of the fruits of *Capsicum* (Fig.6.2,6.3) — *C. annuum*, *C. frutescens*, *C. chinense*, *C. pendulum* and *C. pubescens*.

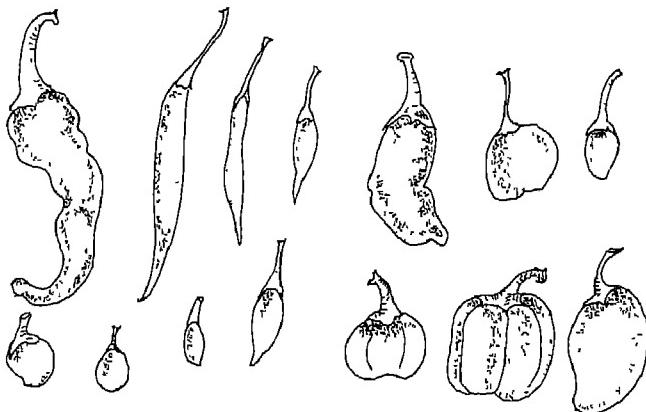


FIG. 6.2
Chilli pepper, fruit

Of these the first two are common. These peppers vary from large, green, bell-like fruits—known as 'Simla murch' — that are not peppery at all to small, green or red chili pepper that are very hot and pungent. Both may be produced by different varieties of the same species, *C. annuum* (Fig. 6.1). *C. frutescens* is more pungent. Crushed and powdered fruits yield a condiment—'Cayenne pepper'. The pungency of the fruits is due to a volatile phenolic compound called capsaicin ($C_{18} H_{23} NO_3$), concentrated mainly in the placental region. Its presence or absence in a pepper plant is due to variation in a single gene. *Capsicum* is also a good source of vitamin C. Paprika variety from Europe, particularly Hungary, is the best source. Albert von Szent-Gyorgyi — a Hungarian scientist — received Nobel prize in 1937 for isolating vitamin C from Paprika. Vitamin A and vitamin E (tocopherol) have also been reported from the fruits (Kochhar 1981).

Certain *Capsicum* peppers are highly prized, not for their beautiful flowers or showy foliage but for their attractive fruits. In certain varieties the fruit changes colour from green in immature fruits to

purple, to orange to brilliant red. One variety called 'Hungarian Wax' pepper has fruits that change colour from green to yellow to orange and finally to red (Fig. 6.3). Some call it the 'banana' pepper due to its colour and shape.

Capsicum peppers are used as food and condiment and also medicinally. Various dishes are prepared in different countries, for example, 'chilli con carne' is a dish from Texas, 'tabasco' is the renowned pepper sauce from Mexico, and 'goulash' is one from Hungary. A combination of chocolate and chilli was a special dish served only to Aztec royalty. 'Mole', a sauce combining chocolate, hot peppers and other ingredients, is a Mexican dish.



FIG. 6.3

Capsicum frutescens, red, yellow and orange fruits — at different stages of maturity. (courtesy Prof. A.K. Bhattacharyya)

Medicinally, the ground powder of *Capsicum* peppers has been used as a powerful stimulant and carminative. In West Indies a preparation called 'mandrum' has been used to treat weak digestion

and loss of appetite. *Capsicum* in powdered form mixed with bran and warm water makes a comforting poultice for the treatment of chest and lung congestion. However, these treatments should not be given to infants (G. Weiss and S. Weiss 1985).

Black Pepper

Piper nigrum (Fig 6.4, 6.5) or true pepper, a member of the family Piperaceae, is a native to southwest India, and was widely cultivated in the tropics of Southeast Asia from prehistoric era. As is indicated by old Sanskrit literature on medicines, pepper has been used in India from time immemorial. Marco Polo during his 24 years journey that started in 1271 from Venice and took him through the Far East observed the use of pepper in China and its cultivation extended to Java. It has been an important commodity of trade between India and Europe. Along with other spices, the Arabian traders used to carry pepper also to the Roman Empire, and soon it turned out to be a medium of 'exchange'. Three thousand pounds (lbs) of pepper was demanded as a ransom for the city of Rome by Aleric, King of Gothe, when he defeated the Romans. The search for a sea-route to India was investigated due to the virtual monopoly of the Venetians and Genoese over the pepper trade. Because of this high-paying trade, the British colonised India and other southeast Asian countries.

The pepper plant is a vine (Fig 6.4) with a woody stem, often reaching a height of about 9 m. The vines show two types of branching. Some of the branches bear numerous adventitious clinging roots, alternately arranged ovate, acute-tipped leaves, and auxillary buds from the swollen nodes. The other type of branches develop from the auxillary buds, have no roots and are fruit-bearing. Numerous flowers are borne on a pendulous spike, white, almost enclosed in the fleshy bracts. About 50 to 60 one-seeded drupes are borne on each spike



FIG 6.4

Vine *Piper nigrum*, bearing pendulous spikes of fruits.

which changes from light-green to red when ripe. In each fruit the thin pericarp encloses a single seed with a hollow center (Fig. 6.5C). Major portion of the seed consists of the perisperm. The minute embryo occupies a small zone at the apex of the seed and is surrounded by a thin endosperm. It grows wild in the forests of Malabar coast and is now cultivated extensively in the Eastern tropics. A bulk of the commercial pepper in the world is produced by Indonesia. The United States import the largest quantity of 23 million kilograms a year.

Black pepper is the dried unripe fruit or berry (Fig 6.5 A-D). White pepper is prepared by soaking the ripe berries in water and removing the outer coat and pulp. White pepper is yellowish-grey and less pungent than black. The pepper contains an oleoresin which imparts

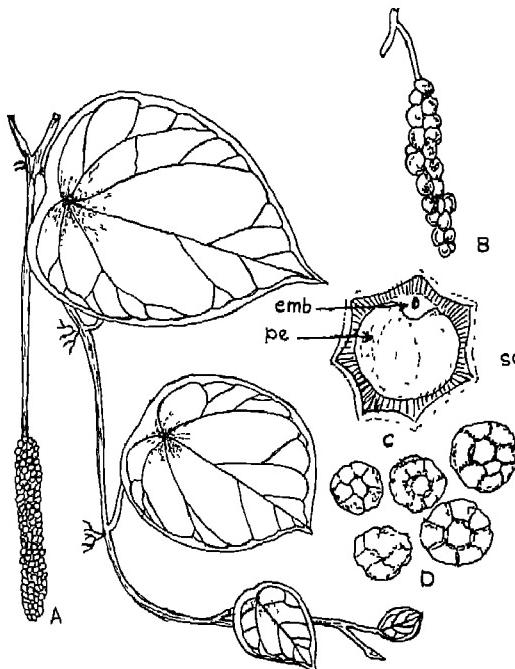


FIG. 65 A-D

Pepper, *Peper nigrum*. A Twig bearing fruits. B Bunch of fruits. C Fruit, transection, note the minute embryo (*em* embryo, *pe* perisperm, *sc* seed-coat) D Mature, dry fruits — the black pepper of commerce.

the pungent taste, and its aromatic odour is due to a volatile oil. An alkaloid, piperine ($C_{17}H_{19}NO_3$) is also present.

Pepper is the most widely used spice in the world. In addition, it has medicinal properties too. The herbalists of medieval times considered pepper as a cure for all diseases. Both oleoresin and alkaloid are extensively used in medicine. Pepper stimulates the flow of saliva, and the gastric juices, and has a cooling effect. There are many culinary uses too.

Clove

Clove is yet another very important spice from the Old World. It is obtained from a tree *Syzygium aromaticum* of the family Myrtaceae. It has an unique distinction and has created history. The clove was a major item of the spice trade of the Middle Ages, and enticed many adventurers of the western world to come out in search of this commodity. Centuries before Christ, the envoy from Java to the Han Court of China, customarily held a clove in the mouth during audience with the Emperor, to keep the mouth perfumed while talking.

During the prehistoric era, the Arab traders brought cloves from the East Indies by ships to the Persian Gulf. The monopoly of the Arab traders was broken by the Portuguese when they discovered the native home of clove, the Molucca Islands, more aptly called the 'Spice Island'. For a long time clove-growing was confined to Indonesia. After a century, it was the Dutch who took control of the clove trade. They destroyed a large number of clove trees to keep the supply in check and sustain high price. In the latter-half of the 18th Century, the french successfully smuggled out cloves from this part of the world to the Indian Ocean Islands and to the New World. Even the French did not stay long and had to bow out to the East India Company of the British.

Although, cloves still come from Indonesia, the largest production is in Zanzibar and Madagascar. Zanzibar produces 90% of world output of cloves.

The clove tree is about 4.5 to 12 m in height, with simple, oppositely-arranged leaves (Fig. 6.6A) dotted with oil glands. Commercial cloves are the unopened flower buds. A single tree may yield as much as 342 kg of dried flower buds. The buds are hand-picked when they show a red colour and are cured by drying in the sun.

The name clove has been derived from the french 'clou', and English 'clout' meaning nail, due to the resemblance of the flower bud to a broad-headed nail (Fig. 6.6B,C).

Dry cloves have deep-brown colour and pungent taste. An aromatic oil called 'eugenol' is the active principle. It is strongly pungent and is extracted by distillation. The clove oil is a yellowish liquid with a reddish tinge. It is used in medicine as a germicide, in perfume and soap industry, and as a clearing agent in histological (Biological) studies. Eugenol is used in perfumery and in the preparation of artificial vanilla. Eugenol is related to carbolic acid group, and it has strong antiseptic and bactericidal properties.

Nutmeg

Yet another important Old World spice tree is *Myristica fragrans*, a member of the family Myristicaceae. Nutmeg and mace are the two valuable spices of commercial importance obtained from the fruit (Fig. 6.7A—E). These evergreen, dioecious, medium-sized trees are native of the Molucca Islands and Sumatra, and are distributed in India, South-East Asia, and the Pacific Islands.

As a dioecious species, all nutmeg trees are not capable of

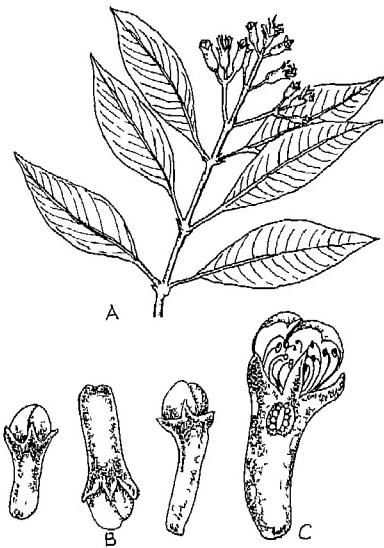


FIG. 6.6 A-C

Cloves, *Syzygium aromaticum*.
A Flowering twig. B Cloves of commerce C Clove, cut longitudinally (ov ovary, og oil gland)

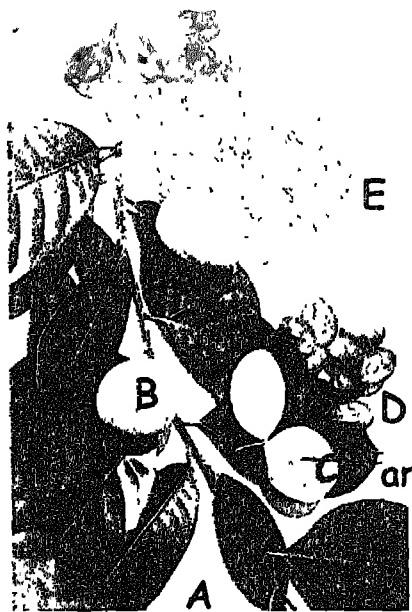


FIG. 6.7 A-E

Nutmeg, *Myristica fragrans*. A Leafy twig. B Fruit. C Same, cut open to show seed covered with aril (*ar*). D Seed. E Aril.

producing the fruits. The fruits look rather like apricots, globose or pyriform, and inside the orange-yellow pulp is a large, hard, ovoid, brown seed, surrounded by a red-coloured reticulately branched protective covering (aril). The seed is the source of nutmeg and the aril that of mace.

The fruits are formed throughout the year but they are harvested only during June to October. Only the ripe fruit with split pericarp are collected. The fruit is picked up from the ground every morning or gathered from the tree using a long stick to which a hook is attached. The seeds that drop out of the fruits are also collected. Mace or the reticulate aril is a bright-red outgrowth from the seed-

coat (testa) which shows deeper colouration on drying. It contains quite different essential oils from those of the seed, the commercial nutmeg. Nutmeg has a strong aroma and a pungent aromatic taste.

The oil of mace and nutmeg is used in flavouring food products and liquors, and in soap industry. Nutmeg contains a fixed oil, a volatile oil, and starch. It is used in condiments, and in medicines as a carminative, astringent, aphrodisiac and also as a tonic. It is mentioned as 'Jati-fal', 'Jati-kosh' and 'Malati-fal' in Ayurveda.

Saffron

Saffron or 'kesar' — as it is known in vernacular (language) — is one of the most expensive plant products. It is often traditionally sold by the goldsmith, and alongwith gold. The reason for this tradition is that apart from its unique aroma, only a very small portion of a flower constitute the 'Kesar' and for just one ounce of it, 4,000 flowers are sacrificed.

A native of Greece and Asia Minor (especially Lavant in Asia Minor), saffron has a characteristic fragrance and a bitter pungent taste. In addition it is an edible dye imparting a characteristic yellowish-red or kesari colour. Kesari (derived from kesar) is a colour that is a symbol of sacrifice. That is why the 'sadhus' usually wear saffron-coloured robes. Even Swami Vivekananda used to wear saffron-coloured robe and turban. One of the colours of our national flag is also saffron symbolizing sacrifices and valour.

Botanically the plant is *Crocus sativus*. The generic name *Crocus* is derived from the Hebrew word 'Karkom' and the Arabic 'Korkum'. The term 'saffron's derived from the Arabic 'Zafaran'. In Sanskrit language it is variously known as 'agnishikha', i.e. with flame-red tuft of the flower filaments, 'bahlika' (from the Bahlika region, probably Asia Minor), 'charu' (beautiful), 'rudhira' (red), 'saurabha' (very

fragrant) and many others. In English it is saffron, saffron-crocus or Spanish crocus. In other Indian languages it is known most popularly as 'kesar' or 'jafran' or 'kumkum kesari'.

The plants are low-growing perennial herbs with an underground corm and six or more radical, narrowly linear leaves with recurved margin. Usually the flowers appear before the leaves, are violet or bluish, solitary or fascicled on a scape. The deep-red or orange tripartite funnel-shaped stigmas are the only part of the plant used in spice-trade.

Saffron grows best in cold regions with warm or subtropical climate. It is cultivated in Spain, Turkey, France, Italy, Greece, Austria, England, Iran, China, and India.

Apart from culinary uses in preparation of different sweets and other dishes like 'pulao', saffron has medicinal values too. The followers of Ayurveda recognize three varieties of kesar or saffron: kesar from Kashmir is deep-red with an aroma of lotus flower; kesar from Bahlika (Bokhara) is also fine but its colour is white and has an aroma of 'Ketaki' or *Pandanus* flower, and the third one from Iran is rather coarse, more or less white, and has an aroma of bee's honey. As a drug it is given as a stomachic, and also as an antispasmodic (Krishnamurthy 1994).

The flowers are picked very early in the morning even when half-open, so as to avoid the heat of the rising sun. The stigmas are then separated and immediately transferred to sieves that are placed on earthen-kilns or pots and on a slow fire. As the cost of the pure product is too high, many adulterants are mixed with it.

Cinnamon

Cinnamon and cassia are two very old spices of the Orient. As reported in the Arthashastra, the powdered arecanut and cinnamon flavoured

certain forms of liquors. History records that cinnamon was one of the items in the spice-trade between India and other western Countries. It has been used from ancient times as a breath-sweetener and as a general tonic. Cinnamon was one of the spices used by the Egyptians for embalming their dead bodies.

Cinnamomum verum (*C. zeylanicum*) (Fig. 6.8) is a small evergreen tree, native of Sri Lanka and South India. The earlier specific epithet *zeylanicum* refers to Ceylon (Sri Lanka of today). The branches of the trees are severed and the bark is removed after giving two longitudinal slits. The three-feet long pieces of the bark are tied together firmly and left for 24 hrs to ferment. The corky outer layer is then scraped off carefully. The dried inner bark produces the 'quills' of commerce.

Because of its sweet aroma and pleasant warm taste, it is used as a spice and condiment, particularly in the preparation of various and rice dishes such as sweet rice, pulao rice pudding. Its use in medicine is against diarrhoea, nausea and vomiting.

Cinnamomum tamala is Indian cassia; its leaves are aromatic and used as spice. In Sanskrit language it is known as 'Tamalapatra'. It is a small tree distributed in the subtropical Himalayas, Khasi and Jaintia Hills. The leaves are carminative, and are used in colic pain and diarrhoea.



FIG. 6.8
Cinnamon, *Cinnamomum verum*,
flowering twig.

C. camphora is a tree native to China and Japan. Camphor oil obtained by distillation of wood gives a high yield of camphor and safrole, highly valued constituents used in the preparation of expensive perfumes. Camphor is also burnt as an incense in temples of the Orient. It has medicinal uses too —as local application for inflammations, rheumatic pains, and sprains.

Cardamom

Around 57 BC Kalidasa, an ancient Sanskrit scholar, described in his plays, our country as covered with large belts of forests. He named and described the prominent trees of these forests. Plants growing in the Malaya Giri region (southern parts of Western Ghats, south of river Kaveri) included 'ela' (*Elettaria cardamomum*) and 'lavanga' (*Syzygium aromaticum*). Kalidas also mentions about chewing betel leaves ('tambulvelli') *Piper betel* with arecanuts (*Areca catechu*), caustic lime, cardamom (*Elettaria cardamomum*) and lavanga (*Syzygium aromaticum*), after meals; it helps in digestion.

Cardamom is a perennial herb, with underground branched rhizome and several erect leafy shoots (Fig. 6.9 A-C). The flowers are borne on long panicles arising from the base. The fruits (Fig. 6.4D) are greenish or creamy-white, ovoid, triangular, shortly beaked capsule with numerous brownish-black seeds. The bulk of the seed consists of a starchy white perisperm, enclosing endosperm and embryo. The pleasant aroma is due to a volatile oil — cardamom oil — contained in the seeds. In Arab countries it is still the most popular spice. Medically it is used to relieve flatulence; it is good for digestion.

Fossil Cardamom, Fossil fruits, apparently resembling a cardamom are reported from a collection of plant fossils of the Deccan Intertrappean beds. These fossils originally belonged to the Museum of Natural History, London, and later loaned to Professor Birbal Sahni,



FIG. 6.9 A—D

Cardamom, *Elettaria cardamomum* A Basal part of plant bearing inflorescence. B Leaf. C Inflorescence. D Fruits (of 'elauchi').

seeds have been exposed and these are with the characteristic wrinkled surface.

Fennel

Fennel is a beautiful, tall perennial herb (Fig. 6.10 A—C), native of southern Europe and the Mediterranean region. The 4 to 5 ft tall plants of *Foeniculum vulgare* have bright-green, shiny stem and

Birbal Sahni Institute of Palaeobotany, Lucknow. Sahni (1934) described it as : "a triangular fruit, marked with longitudinal ridges, and apparently derived from an inferior ovary; the perianth scar is preserved" and named it as *Amomocarpum sulcatum*.

Sahni (1938) illustrated another new species — *Amomocarpum affine* (but there is no description). He illustrated a fruit of the extant *Elettaria cardamomum* (Zingiberaceae) also for comparison implying that the fossil could be of cardamom. Sahni (1940) mentioned that among Hislop's specimens (of the Museum of Natural History, London) were two species of cardamom, which were very much like 'the small green kind that we offer, with other spices, to guests in our homes'.

One of these specimens was so deceptive that a friend actually tried to peel it, till he discovered that it was petrified In one broken specimen the

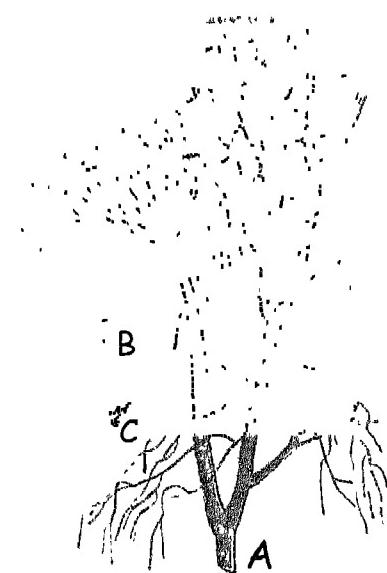


FIG. 6.10 A—C

Fennel *Foeniculum vulgare*
A Twig with flower and fruits.

B Flower. C Fruit

an eyewash, and to increase milk in nursing mothers. Extracted fennel oil can be used or the seeds are made into tea and drunk two or three times a day.

Culinary ways are also many. In Italy, the young soft stalks are served fresh in salads or steamed and sautéed with a little garlic and olive oil. Fennel (in this form) is a favourite accompaniment to pasta dishes of southern Italy. The French like fennel in combination with fish — one favourite dish is grilled fish over burning stalks of dried fennel (G. Weiss and S. Weiss 1985). Dried fennel seeds are important ingredient of curry powder and in preparation of pickles. It is also an ingredient of betel-leaf chewing.

feathery fernlike leaves; bright-yellow flowers in umbels, and green aromatic seeds.

The ancient Greeks consumed fennel to make themselves courageous, the ancient Romans believed it would keep their waistlines trim. The whole plant is aromatic and has both medicinal as well as culinary uses.

It is one of the healing herbs that soothes the stomach and intestine; often used in relieving flatulence, as a good vermicide against hookworm, to sweeten breath, as a gargle,

The fruits are elliptical, green, yellow or brown when ripe; with a long pedicel and a short stylopodium. The two mericarps are attached to the carpophore. There are usually four dorsal and two ventral vittae that contain the essential oil. Fennel oil contains anethole (up to 90% in Roman fennel fruits) and fenchone which gives the bitter flavour to the oil

The left-out, after distillation of oil from the fruits, is a valuable cattle-feed

Cumin

Botanically known as *Cuminum cyminum*, this plant is native of Upper Egypt, Turkey and the Eastern Mediterranean. It has been used in these countries from time immemorial, and finds mention in the Eber's Papyrus (1550 BC).

Cuminum is a low-growing annual herb with a slender, striated stem. Leaves are finely dissected and have a sheathing base. White flowers are borne in compound umbels. It cannot stand heavy rain or heat. The fruits are ovoid, slightly elongated, usually yellowish-brown when dry. The dry fruits have a characteristic pleasant odour but bitter and spicy or pungent taste. It is an important ingredient of curry powder and used in preparation of soups, curries, bakery items, cheese and meat dishes. On distillation the seeds yield a volatile oil used in flavouring and perfume industry. Its chief constituent is cuminaldehyde. Cumin seeds have long been used in indigenous medicine as a stimulant, carminative and stomachic.



The Palm Family

THE Swedish botanist Carl von Linné referred to palms as *Principes* - 'Princes of the Plant World'. No other family of Flowering plants includes so many varieties of handsome trees.

Palms grow in the tropics of both the New and the Old world, and form one of the most distinctive group of trees. There are 217 genera and 2,500 species growing all over the world. Many of them grow in forests but some have been cultivated from time immemorial (for their useful products and their beauty).

The magnificent, tall, unbranched stem of the palms bears a crown of feather-like or fan-like leaves. The older leaves do not fall off abruptly, but gradually decay and persist for a long time on the tree, and fall off by their own weight or get broken off easily by wind or by heavy rainfall.

In *Copernicia torreana* (Fig 7.1A) the dry and dead leaves do not fall off the plant. They surround the lower part of the stem in such a way that the Cubans call this native tree as 'Petticoat' palm.

The staminate and pistillate flowers are rather small and pale. But they are conspicuous by their number as several hundred are borne together in the axil of a spathe. Local people often use the

sugary sap from the cut stalk of inflorescence axis for preparing palm sugar, palm-jaggery, and the intoxicating drink 'toddy'.



FIG. 7.1 A
'Petticoat' palm *Copernicia torreana*, the dry and dead leaves
do not fall off the tree.

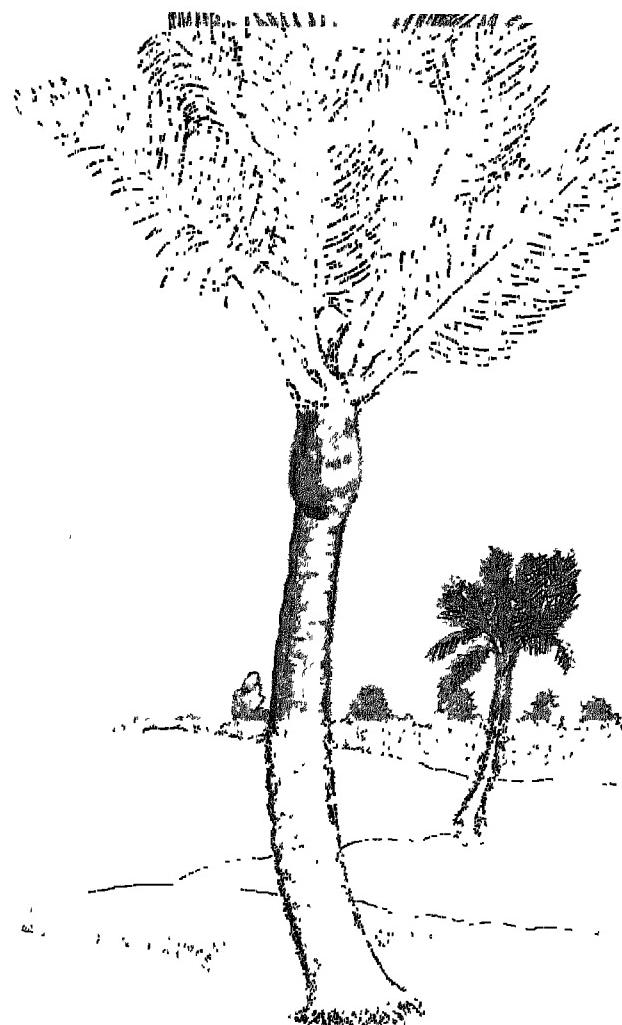


FIG. 7.1 B
Nikau palm, Rhopalostylis sapida, the only member of the
Palm family from New Zealand.

The Nikau palm (*Rhopalostylis sapida*; Fig. 7 1B) is the only member of the palm family, native to New Zealand.

The 'Feathery Cabbage palm' is *Roystonea oleracea*, the commonest native palm from the Guianas of South America to Florida. The 'Cabbage' is obtained by cutting a tree, removing the open leaves from the crown up to their bases, and removing the crisp delicious tissues of the terminal bud. In this process, the tree is killed. The 'Cabbage' is a delicacy in the preparation of 'millionaire's salad' or cooked 'Hearts of Cabbage Palm'. It is a wasteful use of this and other palms and one feels guilty to see these delicacies arranged on the dining table

Royal Palms (*Roystonea regia*) shed their leaves regularly, are 100-125 ft tall, and have slate-grey column-like body crowned by a giant rosette of feathery leaves. This is the national tree of Cuba. It is an excellent regal-looking avenue palm

The Doum palm (or Gingerbread tree) is *Hyphaene thebaica*, native of Egypt and Sudan, introduced to Africa, Madagascar and India. This palm is unusual in its ability to branch several times, each division bearing its own crown of leaves. The fruit has the flavour of gingerbread

'Wax' palm is *Copernicia cerifera* of Brazil, the 'hardest' natural wax with highest melting point is scraped from the severed leaves of this palm. It is used in the manufacture of candles, shoe-polish, and floor-polish.

One of the fan palms remained a mystery for centuries after its giant fruits (Fig. 7.3 A) were first discovered on the shores of Indian Ocean, drifted by storm and ocean current. These rare and weird objects collected by the local inhabitants were offered to the Kings and Chieftains and often fetched very high price. This is the Double

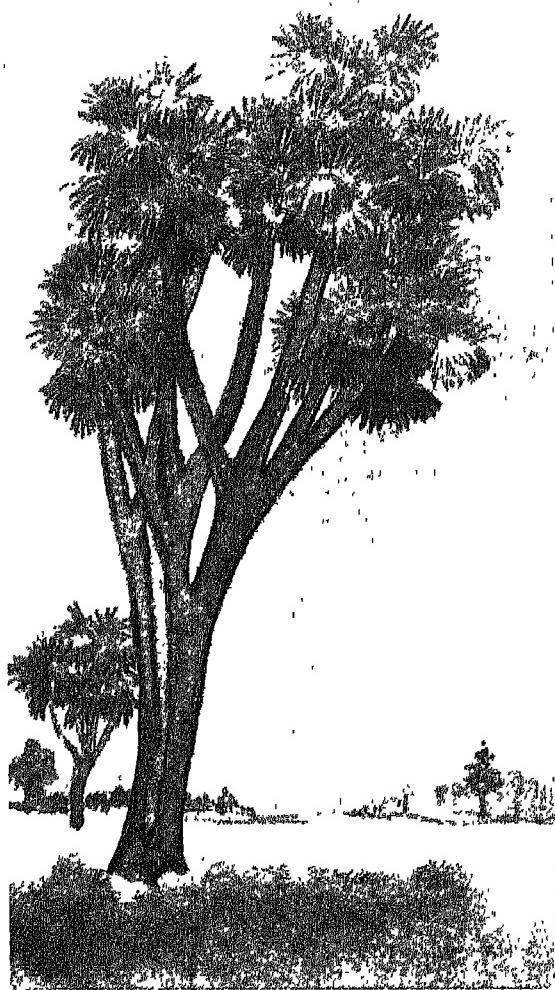


FIG 7.2

Branched palm, *Hyphaena thebaica*, at the Indian Botanic Gardens,
Howrah, West Bengal.

Coconut - *Lodoicea seychellarum* - which grows naturally on the Seychelles Islands of the northeast of Madagascar - a remote tiny group of islands discovered only in the 18th Century. Its fruits became famous as 'Coco-de-mer' (Fig. 7.3A,B); a full grown specimen measures 1 meter in circumference and weighs about 11Kg. These were objects of legend and superstition and were generally believed to belong to a tree that grew beneath the sea. Medicinal values were attributed to these plants. It was a popular belief that those who drank water from cups and bowls made of this shell would be immune against every

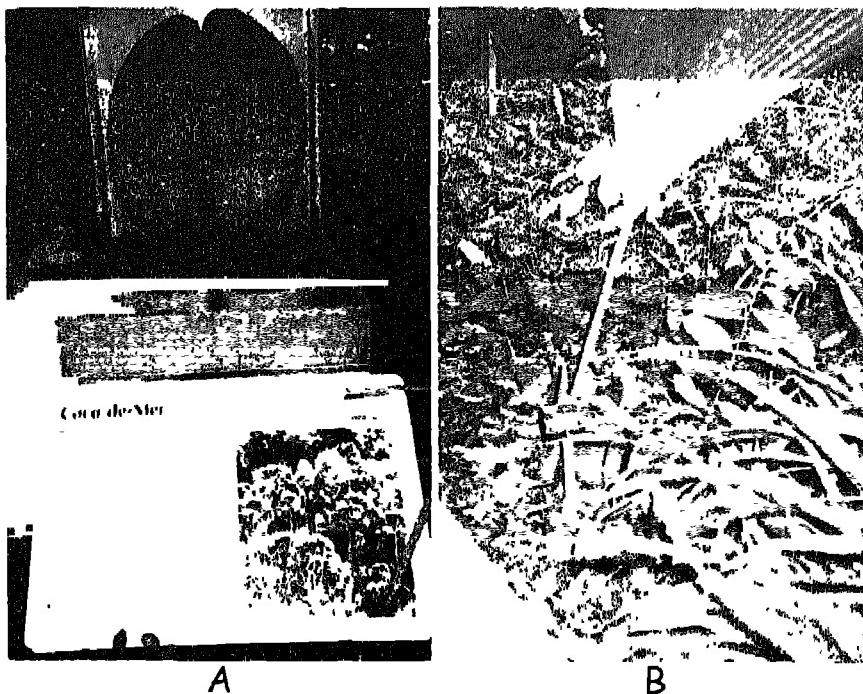


FIG. 7 3 A, B

A 'Coco-de-mer or Double Coconut, *Lodoicea seychellarum* bears the largest fruit and seed. B Germinated seed with the first leaf, at the Royal Botanic Gardens, Kew, London.

poison and disease One of the few earthly possessions of a 'Sadhu' is 'Kamandal' made of the half-shell of this nut

The tree must be at least 30 years old before bearing the flowers and fruits, and it takes full 5 years to mature a cluster of these g_u fruits Only a few fruits are produced in a year.

Fountain or Fan Palm (*Livistonia chinensis*) is a common sight of many gardens where they are grown as potted plants. It is a native of Malaya in East Asia and grows up to a height of 15 meters in nature

The Cane and Rattans are obtained from various species of *Calamus* - mostly distributed in the North-Eastern Hill States and the Western Ghats of India. Although they belong to the same family, their habit is distinct. These are slender climbers but very strong and pliable like a cable or rope. It can attain a length of 90 meters or more The leaves are usually armed with hooked spines that help in climbing The stem of these plants is used as canes for knitting seats and backs of chairs and 'sofas', for making walking-sticks, baskets, cane-furniture and the like Young tender shoots of *Calamus rotung* are used as a vegetable

Coconut Palm

The unripe coconut fruit is an essential part of Hindu religion. Even if coconut does not grow in any region, it must be procured for the offering At weddings and other auspicious occasions, a coconut alongwith a leafy branch of mango is placed near the entry of the house or 'pandal', on an earthen pitcher filled with water. The coconut is adorned with sandalwood paste and vermillion.

Very often it has been noticed that the reason behind a ritual is forgotten but the ritual itself is followed till today. In ancient times in India, human-sacrifice in front of the goddess Kali (or Bhadrakali) was well-known As years passed by, the sacrifice of animals like

goat or buffalo replaced this practice. Ultimately, the change has taken place to such an extent that it is only a symbolic offering of a coconut. A coconut — complete with its outer fibrous covering — resembles a human head, and the two dark spots (on it) resemble the human eyes. Coconut, therefore, has the closest resemblance with a human head and hence this practice.

A folktale about the coconut palm says that Maharaja Trishanku — a very pious king of Solar dynasty (Suryavanshi) desired to go to heaven with his mortal body intact. Rishi Vishwamitra — after practicing severe austerities for a long time — acquired some divine power. In his absence the king had taken good care of his family and the Rishi wanted to repay him by fulfilling his desire. As Trishanku was sent to heaven by Vishwamitra, in his mortal body, Indra (the King of Gods) was very much annoyed and threw him out of the heaven. Indignantly, Rishi Vishwamitra applied his magical powers and did not let Trishanku's body fall on the earth. And Trishanku remained suspended between the heaven and the earth. Vishwamitra, knowing that his magical powers would not last long, held him up with a long pole. In course of time, this pole became the coconut palm tree. The fibers on the coconut fruits symbolically represent the hair of the King and the two black spots, his eyes.

The fruit is considered a symbol of Lord Shiva also, as it has three black spots and Shiva is presumed to have a third eye.

In Gujarat the bride offers a coconut to the bridegroom, and this coconut is preserved by him throughout his life (Gupta 1971).

On the Hindu New Year, it is considered auspicious to view a coconut, as soon as one opens eyes in the morning. According to another belief, coconut will never fall on any human-being as it has the 'eyes'.



FIG. 7.4

Double Coconut *Lodoicea seychellarum*, fruit

In southern parts of India, it is called 'green gold'. Coconuts have floated ashore and established on so many tropical islands that it is difficult to say where this palm originated. Sir Francis Drake came across coconuts in the Cape Verde Islands surrounded by the Atlantic Ocean near north-western coast of Africa, during his visit there in 1577. He wrote in his logbook that within the shell of this fruit was "a kinde of substance very white, no less goode and sweete than almonds". Captain

James Cook along with Joseph Banks and Daniel Solander, reported the occurrence of coconut trees on most of the islands in South Pacific, during his voyage around the world in 1768-1771. The coconuts might have preceded him from South America, where all other members of the genus *Cocos* are native, and float and drift to remote areas such as the Tahiti Islands.

It is also possible that the coconuts might have been brought eastward from Africa by people who first colonized the South Pacific. The daring seafaring inhabitants might have carried them from one island to another.

Coconuts in their husks are a natural 'Canteen' ! They keep fresh for a long time and have within them uncontaminated sweet drinking water as well as nourishment.

Many islanders of the South Seas believe that the coconut trees grow well only in those areas where both the sound of the sea as well

as human voices can be heard. It is also traditional to plant a coconut tree when a baby is born, and to calculate the age of that individual from the plant. After about forty years on a tropical beach, the tree is likely to die due to malnutrition and too little fresh water reaching its roots. It is replaced quickly with a new seedling coconut. A man who survives this second tree also, should be about 80 years old.

Coconut (*Cocos nucifera*) flourishes luxuriously in the vicinity of tropical seas where the soil is sandy and saline. The coasts and backwaters of our Southernmost state, Kerala, are adorned with it. It may be cultivated inland where the soil may not be saline. But, in such areas, a large quantity of common salt must be added to the soil. As the plant is sensitive to both dry climate as well as frost, it does not survive in Northern parts of India. It is a graceful tree with a crown of feathery leaves. Its stem is with a swollen, inclined base, and 12-24 meters high. The ring-like markings (or the leaf-scars) are rather faint. These plants sometimes produce 300-400 fruits each year, although the average may be only one-tenth of this number.

Coconut finds maximal commercial utilization. Indonesians claim that coconuts have as many uses as there are days in the year. Clusters of flower, both male and female (Fig. 7.5 A,B), are borne in the axil of butter-yellow sheaths, throughout the year. Flowers have ample nectar and beekeepers are happy to collect the concentrated palm-honey with the help of the bees. Nine to ten months are required for the fruits to mature. The thick fibrous husk (Fig. 7.5C,D) that keeps the ripe fruit floating develops slowly. In the beginning the shell of the familiar 'nut' (Fig. 7.5E) is soft and full of a translucent jelly, delicious to taste. Later, the jelly liquifies into the clear 'milk' in green coconuts. As the 'nut' matures, its husk turns brown, the shell hardens and inside, the 'milk' or liquid endosperm, gets transformed into the white 'meat' (Fig. 7.6) or the solid

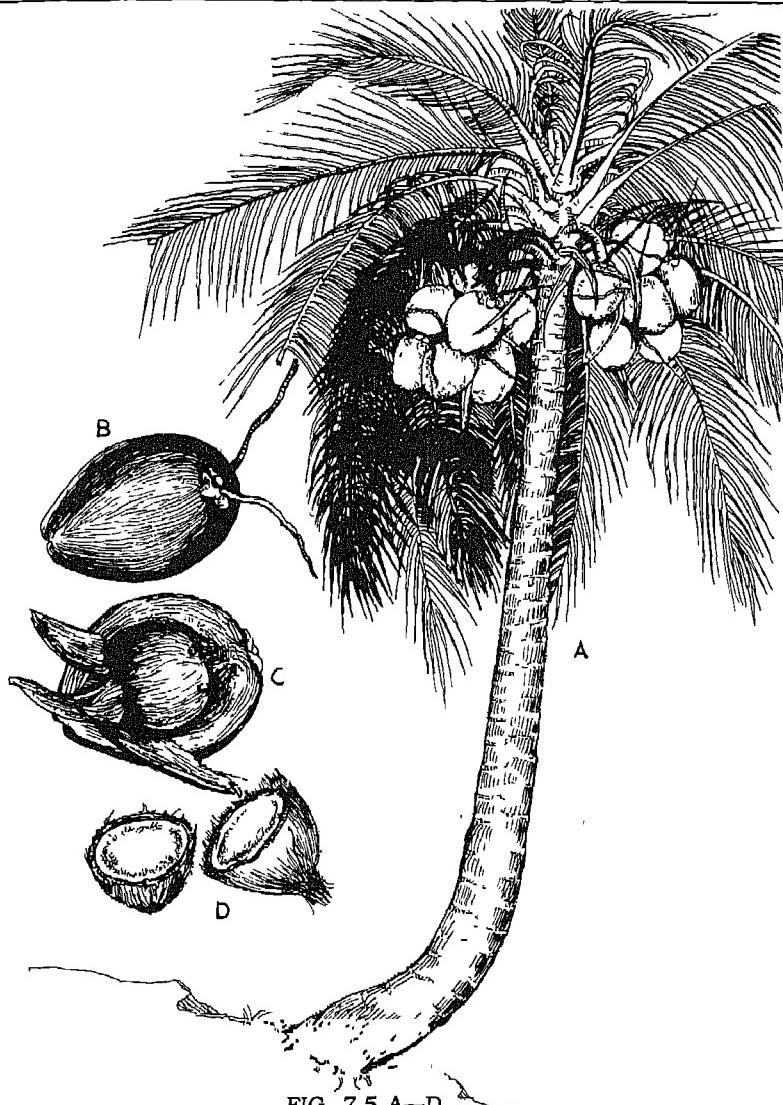


FIG 75 A-D

Coconut Cocos nucifera,

A fruit-bearing upper part of the tree. B Fruit-bearing tree.
C Fruit with husk. D Fruit cut open.

endosperm. Coconut milk is a very refreshing drink. The white 'meat' is equally delicious both in young and old coconuts. The 'meat' from mature fruits — fresh or dried as copra — is used for various culinary preparations. In the southern states of India, hardly a dish is prepared without the addition of coconut. In many other parts sweets are prepared from grated coconut and sugar. It is also customary to offer coconut for worship and to guests during weddings and other social and religious occasions, alongwith betel leaves and nuts. From dry copra is extracted the commercial coconut oil. In Kerala it is the main cooking oil. It is used as hair-oil, perfumed or unperfumed; it is used in the manufacture of soaps, shampoo, margarine and other products. The refuse, after extraction of oil, is the best manure for young coconut plants; also a feed for cattle and poultry.

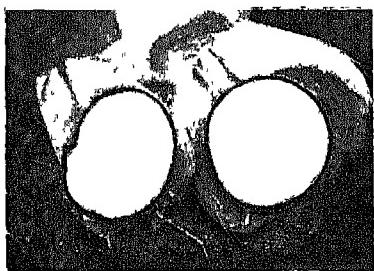


FIG. 76

Cocos nucifera, coconut fruit
cut open into two halves

Coir is a fiber obtained from the husk of coconut fruits. It is very light, elastic and highly resistant to seawater and, therefore, ropes and cables from the fiber are used for tying rafts and boats, and in making fishing nets. It is also used for making floor-coverings, mats, coarse textiles, bristles for brushes, and upholstery. Coir-dust or 'cocopeat', is a peat substitute used in horticulture.

From the young inflorescence stalks, on wounding, a sweet sap is obtained. This is 'nira' or 'toddy' — consumed fresh, fermented or distilled; is also the source of palm-sugar, palm-jaggery, alcohol and vinegar. The soft downy fiber that forms a natural mat at the base of the leaves is used for straining crude coconut oil and 'nira' (after collection). The dry leaves of coconut palm find use in thatching and

basket-work, the midribs are tied together to make brooms, the decay-resistant trunk is used as beams and rafters for huts, and also for making the steps for a pond or lake. Fancy articles are also made from the shell of the nut.

More than three billion coconuts are opened every year. For this reason any nut that is unusual is likely to be discovered, even if that phenomenon is a rare event. One such rare event is the occurrence of a pearl inside a coconut. Usually it is a perfect sphere, about half-an inch in diameter, creamy-white, and with a delicately pebbled surface. Its mode of formation is not known. Another peculiarity is that in Philippines some coconuts are not hollow and are completely filled with fat-rich spongy kernel (Fig 7.6).

Owing to its multifaceted uses, coconut has been called 'The tree of heaven' - 'Kalpavriksha'.

Areca-nut Palm

The areca-nut palm is a slender-stemmed erect palm; native of Malaysia but grown profusely in Indian States of Karnataka, Kerala, Tamil Nadu, West Bengal, Assam and Maharashtra. Areca is perhaps the most graceful and elegant of our palms. The slender stems are straight and ringed as in bamboo and attain a height of 12-30 meters; feather-like leaves are dark-green and bunches of orange-red oval nuts against this backdrop looks wonderful.

The fruit or the nut is the most useful part of this palm. The nuts are cut into smaller pieces and chewed with betel leaves. Sometimes these are 'cured' before use.

'Supari' or Arecanut is an essential article for ceremonial and social occasions, particularly in South and Eastern India. Presenting a 'supari' in some places also indicates engaging a person to commit a murder.

Areca nuts have been an important article of trade since ancient times as it is an important ingredient for betel-leaf (paan) chewing. In ancient Indian literature, it is mentioned to be a common habit amongst men and women alike. The women from Kalidasa's writings used to color their lips red by chewing paan (no lipstick was known during those days). The red colouration is due to a pigment of areca nut which is released as a result of reaction with the alkali (lime) used in the preparation and acts as a mild stimulant and a carminative. The stimulating effect is due to the alkaloid arecoline, ($C_8H_{13}O_2N$) present in the areca nut. Amongst some people, therefore, betel-leaf chewing is habit-forming. But excessive consumption may lead to dental decay and cancer of the mouth parts. In spite of this, today it is probably the most common masticatory in southeast Asia.

Date Palm

Phoenix dactylifera, as the Date Palm is scientifically called, is a typical desert palm of Arabia and Persia (Fig 3.2). It has been mentioned in the Bible. In the desert it grows in oases as deniscens of the desert (It has been considered in the chapter on 'Biblical Scenario').

Talipot Palm

Caryota umbraculifera is one of the majestic palms. The stem (when young) is surrounded by stout leaf bases which fall off in course of time to reveal a beautiful, clean, whitish bole encircled with closely-set ring-marks. The leaf is so large that a single leaf can cover seven or eight men and keep them dry when it rains. They are, therefore, much used for making umbrellas. When the palm attains full maturity, its leaves become smaller and a gigantic flower bud (almost 1 meter in height) develops at the apex. In due course this bursts with a sound and unfolds a lovely white blossom that expands into a majestic pyramid of thousands of cream-coloured flowers, almost to a

height of 6 meters above the leafy crown. At this stage the leaves begin to wither away and fall off leaving behind the fruiting pyramid. The most unfortunate part is that the palm dies after bearing the inflorescence.

Palmyra Palm

The Palmyra Palm, scientifically called *Borassus flabellifer*, is a tall palm distributed along the coastal areas of West Bengal, Bihar, and Western and Eastern Peninsular India. It is sometimes taller than 30 meters and Rabindranath Tagore wrote about it in the poem "Talgachh":

"It is standing on one leg,
Above all other trees, and
Trying to peep into the sky,
Thinking that it can fly
Away with the help of its leaves".

Palmyra has been described by Tamil poets as 'Kalpavriksh' as it can be put on to a number of uses. The famous Tamil poem "Tala Vilasam" enumerates 801 different uses of this palm. Like coconut palm, every part of Palmyra can be used in one way or the other. The leaves were used as the chief writing material in the olden days. Some of the manuscripts of old literature of our country have been written on these leaves. In some places the practice of writing is still followed when young boys and girls are ceremoniously initiated into the alphabets. Like coconut, toddy is collected from this palm also and consumed fresh or fermented. The fruits are edible. The old tree trunks are used as rafters and pillars for huts in country homes. The leaves are made into hand-fans.

This is one of the palms in which male and female flowers are

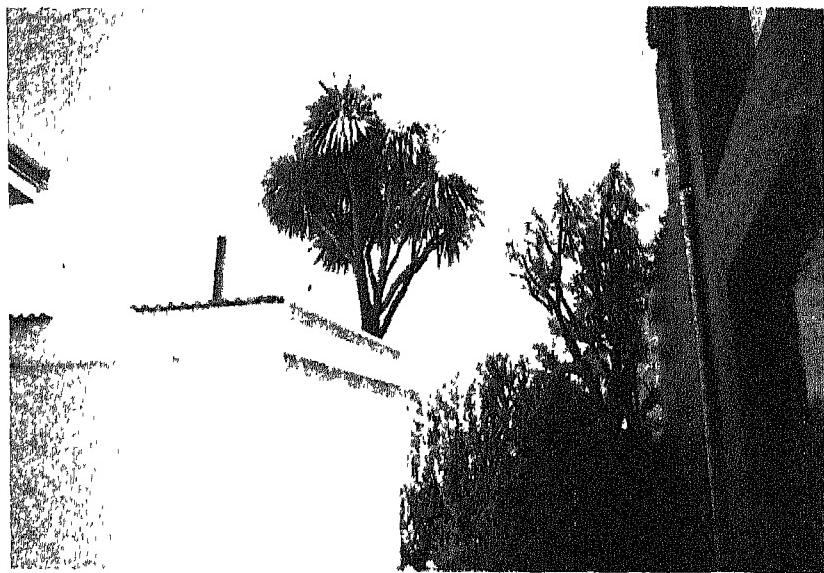


FIG. 7.7

Hyphaenae thebaica in flowers. Lincoln University Grounds,
Christ Church, New Zealand

borne on separate plants. The toddy collected from the male plants is sweeter and palm-jaggery, palm sugar and sugar candy are made from it. It is consumed as a fresh or fermented drink. Sugar candy is used as medicine against coughing. The unspent toddy is converted into vinegar.

Fish-tail Palm

Caryota urens (the Fish-tail palm) is named so as the leaflets resemble the tails of fish (Fig. 7.8 A-C). These are magnificent, tall trees often grown in gardens, but also grow wild in most forest regions of our country. The leaves of this palm do not form a compact crown. Instead, they arise successively over a good length of the trunk. The

flowers and fruits (Fig. 7.8C) arise in very long pendulous branches and remain so for a long time.

The Fish-tail Palm has several uses. The fiber growing outside and within the leaf sheath, flowering sheath and stem constitute 'kittul' or 'salopa' fiber. Ropes made from this fiber are very strong, used to tether elephants and for tying ocean-going steamers. It can also be used in hanging baskets for growing plants as it would retain water for a longer time. The juice from the floral stalks is used in the preparation of palm-jaggery, toddy and 'arrack'. Kittul flour or sago is obtained from the starchy interior of this plant. The nuts are hard and are used for making beads and buttons.

The African Oil Palm

The African oil palm, botanically *Elaeis guineensis*, is an important oil crop. For a long time, only the wild palm plants were used as the source of vegetable oil in West Africa. Presently, there are extensive plantations in Africa as well as other tropical countries.

It is a handsome erect tree attaining a height of 20 meters or more, with a crown of 20-40 massive leaves. Male and female inflorescences are massive compound spadices borne in the axil of the leaves — female in the lower axils and male ones in the upper axils.

The fruits are borne in large bunches (Fig. 7.8 D), each containing a variable number of fruits (200-2000). An yellow to orange-red coloured oil is obtained from the fleshy pulp of the fruit, the colouration is due to the presence of large quantities of carotene, particularly β -carotene. The fatty oil containing myristic acid (1.0-2.5%), palmitic acid (32-43%), stearic acid (1-9%), oleic acid (40-53%) and linoleic acid (2-11%) is more or less solid at room temperature.

Elaeis guinensis also yields palm kernel oil from the kernel or

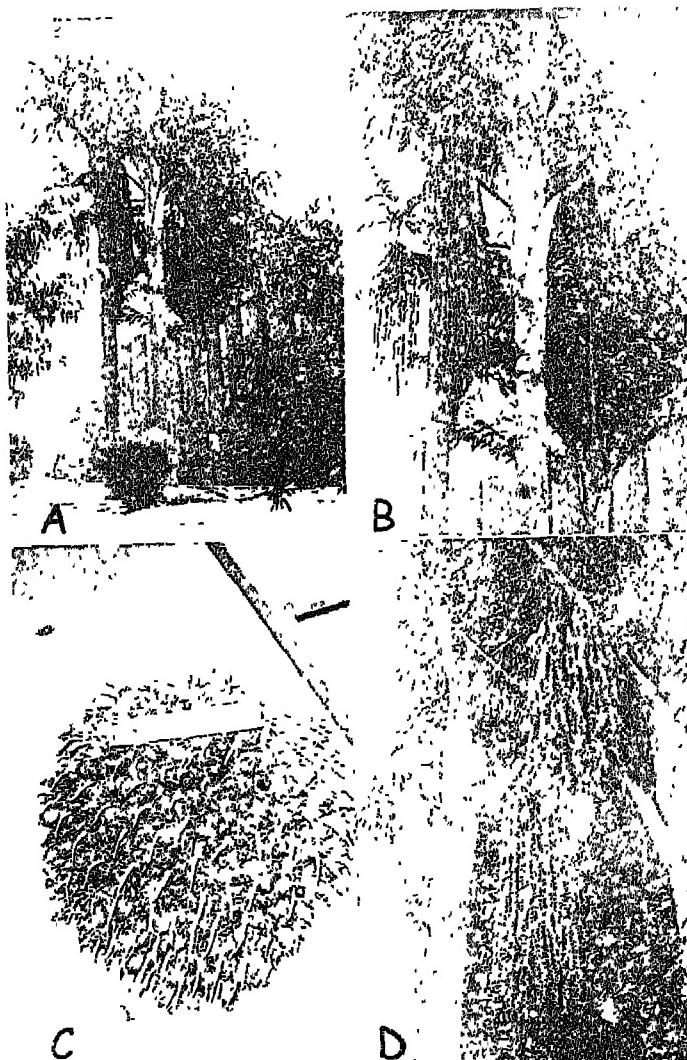


FIG. 7.8 A-D

Caryota urens, A-C, B Fishtail palm in the grounds of Gargi College, University of Delhi. Note the hanging inflorescences.
C Oil palm. D Oil palm - a bunch of fruit.

endosperm. Like coconut oil, this oil is used in the manufacture of glycerine, shampoo, soaps and candles. Better grades of the oil are used as a substitute of cocoa butter, and in the manufacture of margarine.

Palm-wine is prepared from the sap obtained by bruising the male inflorescences.

There are a few oil-plams in the botanical garden of Calcutta, Bombay, Bangalore and other places.



The Water-Lily Family

AQUATIC plants with beautiful flowers have played an important role in the making of the water-gardens, particularly in Egypt, China, India and Japan.

Water-lilies (*Nymphaea* spp.) were grown in the ancient temples in Egypt. Its flowers were often used for decorating the tombs of the important personalities during 1,500-2,000 BC. Olive and Willow leaves were discovered alongwith waterlilies in the coffin of the boy King Tutankhamen with papyrus forming the framework of a necklace of these flowers. Hieroglyphics named these flowers as lotus and not water-lily. But, as lotus does not belong to Egypt, these must have been the flowers of water-lily of the tropics.

The ancient water-gardens of Japan and China also made full use of the water-lilies and lotus. For the early man, water-lilies had important properties — food and medicine — and so it gained importance in folklores, symbolism and religion. Many advertising agencies use the motif of the white water-lily flower if their products are associated with freshness and relaxation.

Some members of the water-lily family are discussed in this Chapter.

Sacred Lotus

The Scientific name *Nelumbo nucifera* is the latinised form of the Sinhalese (Sri Lanka) name 'nelumbu'. The word Lotus is from the Greek 'Lotos'. The Sanskrit names 'Abja' and 'Saroja' mean water-born, and 'Kamala' means rosy, excellence or desirous (Gandhi and Singh 1989).

In Hindu mythology, lotus is the cradle of the universe. When the deluge swept away everything, Lord Vishnu lay upon the waters and lotus flowered from his naval. Brahma, the Creator, emerged from it and created the world. Aryan cult of the Mother Goddess was adopted by the Aryan Hindus and the Goddess Shree or Lakshmi, the consort of Vishnu, is associated with the lotus. Lotus born (Padmaja, पदमजा), sitting on lotus (Kamalasana, कमलासना), Lotus-coloured (Kamala, कमला), lotus eyed (Kamalalochana, कमललोचना) are some of the attributes for Goddess Lakshmi. The Goddess of learning (knowledge) — Saraswati, is associated with white lotus; often said to be shweta-padmasana (श्वेत-पदमासना) — seated on a white lotus.

In Vedic mythology when the 'ocean of milk' was churned by the gods and the demons, Lakshmi sprang up with a lotus in Her hand. The Vedas also mention the heart, the abode of gods as Haridayakamalam (हरिदयकमलम्), i.e. a lotus-like heart or a heart as pure as a lotus. Lotus is compared, by the Hindus and the Buddhists alike, with a man who remains unaffected by the wickedness of the world. The leaves of lotus are such that water drops cannot stay on its surface and fall off with the slightest movement. Human life has been compared with water-drops on a lotus leaf.

In Yoga, the lotus position is adopted in exercises by those who strive to reach the highest level of consciousness.

In the writings of Kalidasa, an ancient Indian scholar, beautiful



FIG. 8.1

Lotus, *Nelumbo nucifera*, circular waxy leaves and pink flower

women are compared with parts of the lotus flower; her eyes are like lotus, her arms like the pedicel or stalk of the flower; even the feet are compared with lotus (pada+ aurobindo = padaraubindo or Charan kamal, पदारविन्द, चरणकमल) and others. The Goddess Durga makes her annual visit to the earthly home alongwith her two sons and two

daughters. The daughter Lakshmi sits on a red or rose-coloured lotus, and the daughter Saraswati on a white lotus !

Sun and lotus are interdependent because the lotus flowers open in the morning with sunrise. Lotus is the main flower for the offering to the Sungod, Surya.

It is said that before starting the war with Ravana, Rama worshipped the Goddess Durga with 108 lotus flowers. The practice of offering 108 lotus flowers to Goddess Durga is continued till today.

In Mahabharata, King Shantanu, father of Bhishma, wanted to marry Satyavati as he was enchanted by the lotus-fragrance emanating from her.

A famous Bengali poet Rajanikanta Sen has written:

"Why are you afraid of plucking the lotus because of the spines on its stalk?

Is it possible to have eternal happiness without sorrow on this earth?"

The lotus (*Nelumbo nucifera*) is a large perennial aquatic herb (Fig 8.1) with a stout, creeping rhizome, growing in the ponds, tanks and lakes. The flowers and the leaves of the lotus rise a foot or more into air, the waxy petals spread like a decorative bowl around the broad receptacle (Fig 8.2A,B). Within its flat top are embedded numerous carpels (Fig 8.2 E, F). A thick fringe of golden-yellow stamens surrounds the receptacle (Fig 8.2 B-D). When the petals and stamens fall off, the nut-like fruits ripen in their individual 'pockets'. At this time the entire receptacle breaks away from the stem and floats for weeks. Gradually, the edge of each 'pocket' rots, and the seeds (Fig 8.2 G,H) are released — they sink and germinate. As the wind blows, the floating fruits move from place to place and the lotus

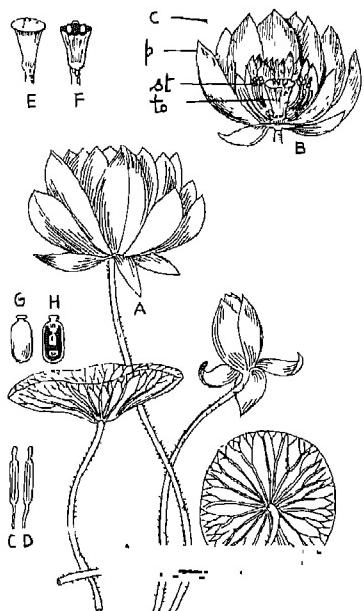


FIG. 8 2 A—H

Lotus, Nelumbo nucifera,
A Flower and leaves.
B Longisection of flower to
show perianth lobes, stamens
and torus. C, D Stamens.
E, F Torus with embedded
carpels. G, H Seeds, entire and
longisection.(c carpel, p petal,
st stamen, to torus)

gets distributed easily around the shores of large lakes and along great rivers.

Man has also helped in its distribution and that is why the sacred lotus of China, Tibet, and India, is depicted on some of the most ancient decorative drawings of the Nile river valley in Egypt, where it grows in almost every marsh. Lotus was introduced to Egypt around the time of the Persian invasion in 523 BC. The fruits have long been 'regarded' highly in this country as 'Sacred beans'. Lotus seeds remain dormant over a long period. Some sprouted in 1947, after 237 years in dry storage, as specimens in the Hans Sloan collection at the British Museum (Natural History). Some lotus seeds reported to have been dug from an ancient lake bed in Manchuria, were brought to Tokyo in 1951 — all of these germinated. Careful studies of the seed-coat of two seeds received in USA, by using radioactive C_{14} technique, proved them to be about 1,000 years old.

The Giant Water-lily

The giant water-lily — *Victoria amazonica* (Figs 8.3,8.4 A) as it is scientifically known — was discovered in South America in 1801.

t seeds were sent to England in 1837 by the leader of an
on for the Royal Geographical Society, Sir Robert Schomburgk.
en on, major horticultural institutions rivalled each other to
a flower of this new plant. Sir Joseph Paxton, head gardener
th Duke of Devonshire at Chatworth in Derbyshire, succeeded
ng the plant flower in the giant conservatory on the estate.

huge circular leaves, which grow to 6-7 ft in diameter, have
beautiful network of veins on the underside (Fig. 8.4B).
ng to some, this pattern of venation inspired Sir Paxton to
he ill-fated Crystal Palace, a huge conservatory which was
ed by fire in 1936. A similar conservatory at Chatworth also
a tragic end when the IXth Duke destroyed the building in
ter many of the plants had died as a result of fuel shortage.



FIG. 8 3

Giant Water-lily, *Victoria amazonica*, plant with largest leaf;
photographed at Royal Botanic Gardens, Kew, London.

This incredible plant is romanticized by some legends told by the local American Indians. In one such folklore, the *Victoria* flower is the beautiful daughter of a chieftain of one of the tribes, who threw herself into water and disappeared after seeing the reflection of her wandering lover — the moon.

The generic name *Victoria* commemorates Queen Victoria who was presented with a leaf and a flower of this newly-acquired wonder in 1849. The specific epithet *amazonica* reminds one of its native land. The magnificent gigantic waterlily occurs especially in northern South America, frequently covering the water surface for miles. *Victoria* was first observed by Thaddaeus Haenke in Bolivia in 1801. Edward Friedrich Poeppig rediscovered this plant around 1830 in the river Amazon and named it *Euryale amazonum* in 1832. Subsequently, other species of *Victoria* were spotted in many rivers of the northeastern and eastern parts of South America.

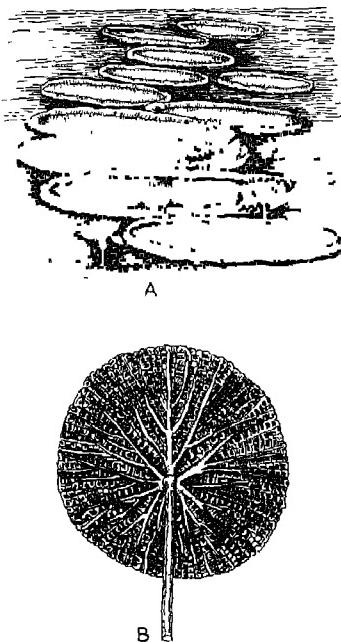


FIG. 8.4 A,B

Victoria amazonica. A Huge circular leaves; white flowers turn purple overnight after pollination. B Underside of the leaf to show network of veins

The flowers and leaves emerge from a thick rhizome, about 8 in (20 cm) in diameter. Although the young leaves are about 6 in (15 cm) in diameter, depending upon the depth and warmth of the water and the day-length and light intensity, growth is very rapid and in 2 to 3 weeks time the leaves assume a diameter of 6 to 7 ft (1.8-2.1m). The leaves are brightgreen with upturned red edges and hence the common name 'water platter' amongst the Indians of British Guiana. The upper leaf surface exhibits numerous low mounds which trap air in a honeycomb of interlocking air pockets between the ribs on the lower surface of the leaf. Due to this feature the leaves become so buoyant that they can support from 100-200 1b of weight. Victorias are often photographed with a child sitting on a leaf. A closer look will often reveal a floating support under the leaf designed to distribute the weight evenly over the whole surface. The purplish under-surface has massive veins and ribs radiating from the center and projecting into water in a skeletal fashion.

The nocturnal flowers are also impressive. The buds are pear-shaped and prickly and borne on prickly stalks. The open flowers are about 12-14 in (30-36 cm) across and have numerous white petals arranged in several rows. The colour changes from white to pink and then purplish-red on successive evenings. Robert Schomburgk, who brought the seeds in 1837, recalled that the flowers released an intoxicating fragrance (similar to that of crushed pineapples) in the evening, when they opened. Each flower lasts for three days, closing shortly after sunrise on the third morning in a glowing purplish colour and sinking under water where it rots. The pea-like seeds are produced in a prickly fruit as large as a coconut. The starchy seeds are edible, and are called 'maiz del aqua', or 'water corn', in parts of South America.

Pollination biology of *Victoria* is also interesting. The buds that

are ready to open appear above the surface of water and open around sunset. With the opening of the flowers there is an emission of strong odour accompanied by increase in the temperature inside the flower, and this condition lasts for about 6 hours. The strong scent of the flowers spreads far and wide owing to high temperature. The difference in temperature inside the flower and the surrounding atmosphere may be as high as 11° C.

Later on, during night, the flower is visited by the pollinator — a scarab beetle (*Cyclocephala hardii*). As the flowers are quite large, as many as a dozen or more beetles visit one flower at a time. The beetles move through the young undehisced anthers into a cavity at the base of the flower. Here the female receptacle, i.e. the gynoecium, receives the foreign pollen brought by them. At night the temperature of the flower becomes normal and the fruity fragrance lessens. The innermost petals change colour to pink and by the morning the flower closes and the beetles remain imprisoned. But they are happy to feed on the special starchy floral structures — the staminodes.

Next afternoon the flowers appear dark-reddish purple and when they reopen the beetles get released. By now they are covered with a sticky floral secretion and as they move through the anthers, they get showered with pollen. These beetles, now carrying a large quantity of pollen, fly off to visit a freshly opened snow-white 'first-night' flower. It has been noted that these beetles are very specific about their choice of flowers as they do not visit any other plant except *Victoria* (Kaur 1981).

On the third day the fertilized flowers start sinking to the bottom of the lake. The seeds mature and develop a gelatinous tissue around itself which keeps them afloat when the flowers decompose. The seeds remain floating for a day or two only as the jelly-like mass gets washed

soon and the seeds sink to the bottom, germinate and form a new plant.

Victoria occurs naturally in shallow inlets, lakes and pools, in bogs, and can be cultivated in large greenhouses (Fig. 8.3) or in outdoor heated tanks. It was introduced in India from seeds produced in Britain and is a close relative of the water-lilies growing here.

Water-lily

Men long for immortality and they also honour purity. Both these qualities are common to the water-lilies and that is why they are so popular. Every year the plants of water-lily disappear when the flowering-season is over. And yet, with the onset of the rains, they reappear as pure and beautiful as ever. Hence, the plants of water-lily are considered to be 'immortal'. For 5,000 years the Egyptian lotus, actually a blue water-lily (not *Nelumbo* of the Far East) was treated as a symbol of resurrection. In these plants, at night, the floral petals become folded together and the blooms submerge. The following day they reappear and open into a full bloom as usual.

The seed-pods of both *Nymphaea* (water-lily) and *Nelumbo* (lotus) are presumed to have been inspired by 'cornucopie', an ancient emblem of fertility. The Swastika symbol of the Hindus has also been attributed to water-lilies.

Nymphaea is native to India, but very early spread to other parts of the world. Water-lilies were grown in the temple gardens of Egypt and the flowers were used for decorating the tombs of well-known priests, about 1,500-2,000 years before Christ. Although these flowers were named as 'lotus' they were, in all probability, either blue water-lily (*Nymphaea coerulescens*) or the white ones (*N. lotus*).

The generic name *Nymphaea* is derived from a Greek word 'Nymphaia', a flower that arose from a nymph who died due to jealousy.

In the 1st century AD, the Roman historian and naturalist Pliny, associated water-lilies with a nymph who died because of her unreciprocated love for Hercules, the Greek god.

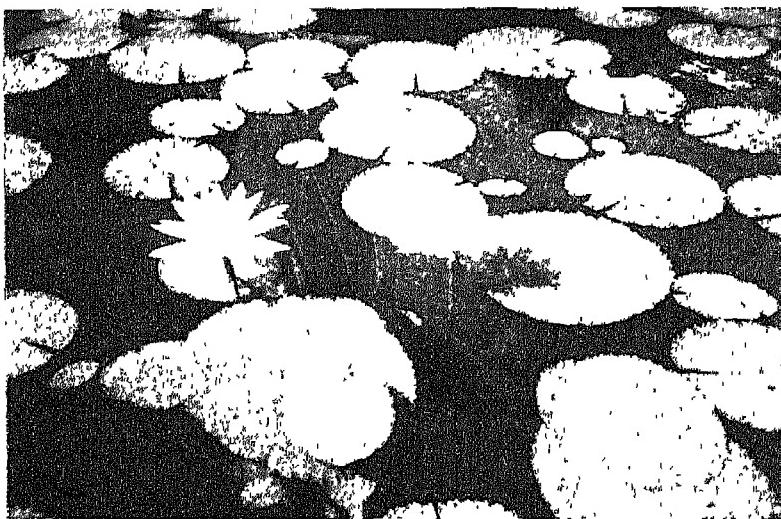


FIG. 8 5

Water-lily, *Nymphaea lotus*, note white flowers.

In Sanskrit literature 'Amarkosh' — names for white *Nymphaea* are 'Sougandhika' and 'Kahlar', for red flowers 'Hallak' and 'Raktasandhyak', and for blue flowers 'Indibar'. In Sanskrit *Nymphaea* is also known as 'Utpal' 'Kumudini', 'Kairab', 'Nalini' and 'Kumudvati'.

Nymphaea is a perennial aquatic, and grows in ponds, pools and lakes (Fig 8.5). It has an attached floating part with the rhizome in the soft mud below, and leaves and flowers on long stalks above the surface of water. The peltate leaves are often used as plates for serving food. The beautiful flowers and the leaves together cover the entire surface of water. The berry-like fruit contains numerous black seeds. The spongy aril keeps the seeds afloat for sometime and helps

in dispersal. Later, the aril disintegrates, the seeds sink to the bottom of the pond, and germinate in the next season. Yellow-flowered water-lily or *Nymphaea lutea* is rather uncommon. A few years back some plants were located in the Ramakrishna Mission Ashram in Haridwar.

The leaves are used as dinner-plates; the stalks of leaves and flowers have medicinal value in dysentery; powdered rhizomes are used for afflicted piles. The seeds are edible after popping.

The Gorgon Plant

This common name is applied for another perennial plant of the water-lily family, *Euryale ferox* (Fig. 8.6A-H). Densely prickly appearance of the plant reminds one of the fierce thorny locks of hair of the mythological demon Gorgon.

It occurs in India in fresh-water tanks and lakes in Kashmir, Alwar in Rajasthan, Uttar Pradesh, Bihar, West Bengal, Assam, Tripura and Manipur. It was introduced to Europe in 1809 by William Roxburgh, the then director of Royal (now Indian) Botanic Gardens at Sibpur, Howrah.

Euryale ferox is native of the southeast Asia and China and has

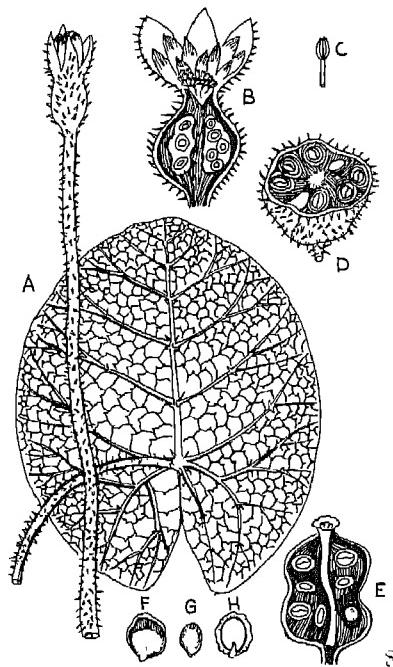


FIG 8.6 A — H

Euryale ferox. A Flower and leaf. B Longisection of flower to show the floral parts. C Stamen. D Transection of ovary to show the carpels. E Same, longisection. F-H Seed with and without seed-coat and longisection (H).

been cultivated for centuries as food plant. The fruits are edible and the seeds — usually of the size of a pea or a cherry — are roasted and eaten. On roasting, the seed-coat swells and bursts and can be peeled off. The seed-flour is nutritious and easily digestible. The local name of the roasted seeds is 'makhana' and is used in the preparation of sweet-dishes.



The Hallucinogens

HALLUCINOGENS are certain drugs that can bring about changes in the way of thinking and feeling of a person. There are many natural plant and plant products that are hallucinogenic. They all have in common the power to produce initial cerebral stimulation that induces illusions, fantastic visions, unusual amusements followed by hilarious laughter and fear, and later intense cerebral depression. Hallucinogens not only distort mind but also change a personality. A constant user of such drugs loses his feeling of earthly existence, slowly the memory fails, and powers of observation and ability to reason are lost. Even then, the hallucinogens have long been used in association with religious rituals. Many people presumed that these drugs promote spiritual growth, enhance perception, stimulate personal development and open up realities.

Many fungi, commonly known as 'Teonanacatl' or 'flesh of gods' have been used by the Aztecs of South America in their religious performances and are known to produce intoxication. *Conocybe siligineoides*, *Psilocybe mexicana* and *Stropharia cubensis* are some such fungi which are known to contain psychoactive chemicals, psilocine and psilocybine (Kochhar 1981).

Ancient Indian literature mentions about a drink 'Somarasa'.

Over 144 hymns of the Rig-Veda contain a reference to 'Soma' or 'Somarasa' — a drink of the gods ! These drinks are said to have had an exhilarating and activating effect; believed to concentrate the mind of the consumer and cure him of all his maladies. In spite of these special virtues, the original source of 'somarasa' has remained a mystery. It could be one of the species of *Rheum*, *Ephedra* (*E. pachyclada* or *E. intermedia*) or *Sarcostemma* (*S. viminale* or *S. brevistigma*). However, R. Gordon Wasson (1969) identifies 'Soma' as *Amanita muscaria* known commonly as 'fly-agaric'.

The dried seeds of 'Nutmeg' or 'Jaiphal' (*Myristica fragrans*) is also said to have hallucinogenic properties. Of all the hallucinogens, *Cannabis* is supposedly mild, peyote is stronger but the strongest is the chemical 'Lysergic acid diethylamide' (LSD). Opium (from *Papaver somniferum*) has two effects — it is an important source of the pain-killing drugs morphine and codeine, and also the habit-forming hallucinogen opium. Some of the important hallucinogenic plants are discussed in this Chapter.

Opium

The history of opium can be traced back to 4,000 BC. The wild poppy is believed to have originated in the region around the eastern Mediterranean. It was probably domesticated for its seeds which have a nut-like taste. The culture for seeds spread through central Europe, probably in the Neolithic age (Johri and Srivastava, 1978). The garden poppy was well-known to ancient Greeks, the Romans, the Egyptians and the early lake-dwellers of Switzerland. Homer, in the 'Odyssey' described the use of an infusion of the drug as a beverage of hospitality. The drug was also known to the ancient Mesopotamians. Ancient Egyptian literature refers to the use of opium, a preparation believed to have come from the gods. In the days of Hippocrates and

Dioscorides, poppy was grown in Asia Minor and its fruits were used for the preparation of a soothing beverage for patients and a mild sleep-inducing potion to keep children quiet during their teething troubles (P. Maheshwari 1965).

Dioscorides mention opium in his *Materia Medica* as a pain-easer and sleep-inducer. Lucian, in his *True History*, gives a vivid description of his visit to the 'Isle of Dreams' and the 'City of Sleep' wooded by 'plants of poppy', and 'mandrake' which is the abode of countless number of birds.

Queen Bernice, wife of Ptolemy Logus, who lived on the Island of Kos, used a sedative (made of opium and mandrake) during child-birth.

Hippocrates and his disciples experimented with opium but considered it unsatisfactory as a pain-killer. The pain-relieving property of morphine, one of the active principles, was investigated by Friedrich Wilhelm Sertuerner, in the early 18th Century. He discovered that the effect of the drug was deep sleep with pleasant dreams. He named the active principle in opium as 'morphium', a name derived from the Greek god of Dreams, 'Morpheus'. In 1931, Sertuerner was felicitated by 'Montyon prize', and the distinction of being known as one of the 'benefactors of humanity'.

The Arabian physicians were also well-versed with the use of opium and the traders form these countries introduced the drug to the Old World, including Japan and China. The plant and its products were unknown in ancient India and China.

There is no reference to opium in ancient books of Indian Medicine. It is probably in a work on toxicology by an ancient author, Narayanan, in 862 A.D., the use of opium in the treatment of rat-poisons is mentioned. Later publications such as *Bhavaprakash* (16th

century) and *Sharanga Dhara* (14th Century) also mention about opium in several medical preparations (Krishnamurthy 1994).

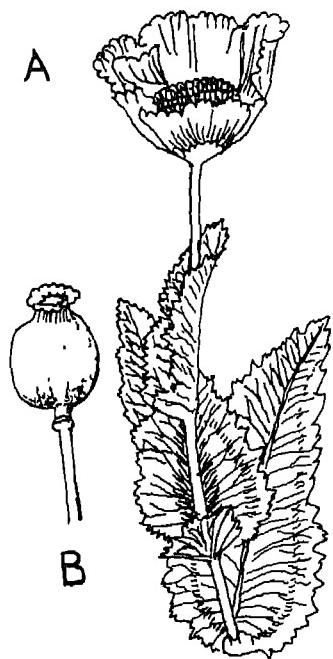


FIG 9.1

Opium, *Papaver somniferum*.
A Leaves and flowers. B Fruit.
for the Chinese was not the question. Even Queen Victoria turned a deaf ear to the personal appeal of the Chinese Emperor to stop this trade.

Between World War I and II, the illegal cultivation of poppy became established in the mountains of western Mexico also.

Opium is the dried latex obtained from the incisions made on mature capsules of *Papaver somniferum* (Fig. 9.1A,B). Both crude opium

At present India and China are amongst the four major countries (other two are Turkey and Russia) which are the source of opium. Opium-smoking in the Far East began long after the discovery of America. Prior to opium there was no custom of smoking anything in the Old World. Its export from India increased and the opium trade became more and more profitable. The British East India Company took interest in this commodity. In exchange for the opium sold to China, they would buy tea for export to England and even to the New World across the Atlantic. Because of opium, two battles were fought between Britain and China, in 1840 and 1855. Might triumphed over right. Whether opium was good or bad

and empty dry capsules contain a large number of toxic alkaloids. Based on their chemical structure and action, these alkaloids are placed in two groups. Morphine and codeine are analgesic, narcotic and potentially addictive. Papaverine and noscapine are not analgesic, narcotic or addictive. Morphine has been the standard pain-reliever for a long time. Codeine is both pain-killer as well as suppressor of cough. Papaverine is used in circulatory diseases as it relaxes contractions of smooth muscles, and noscapine acts like codeine but is not addictive. Thebaine is yet another alkaloid of therapeutic value but is not a narcotic. Crude opium and morphine are subject to international narcotic laws. Growing of poppy plants and production of morphine is, therefore, under the strict supervision of the Government. And, inspite of such vigil, illegal transportation of opium across the borders is a very common practice.

Because of its therapeutic importance, researchers are still producing better varieties. The two improved varieties — Shyama and Shweta — have been developed. They yield 40% to 50% higher latex than the existing cultivated varieties. Another variety 'Sanchita' is rich in morphine.

Peyote

This well-known hallucinogen — peyote or mescal-button — is obtained from a spineless Cactus — *Lophophora williamsii* (Fig. 9.2) that grows in northern Mexico and in Texas. The word 'Peyote' (Spanish language) is derived from a local term *peyotl*.

Peyote was first described by a physician named Hernandez. He was sent by Philip II of Spain in 1570 to study the resources of 'New Spain' (Mexico).

The hallucinogen has been used by the American Indians, since time immemorial, and the custom is known as 'Peyotism'.

The old peyote complex flourished before the 20th century. It was

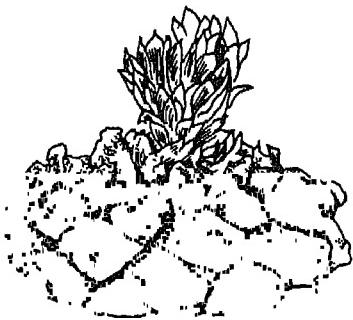


FIG. 9.2
Peyote, *Lophophora williamsii*

used mainly as medicine and also to be able to get visions for supernatural revelations. It was customary to use it during tribal dancing ceremonies so that the dancers would concentrate more on dancing, as if in a trance. Peyote finds mention in the archaeological remains of pre-Columbian era, in Mexico. Various documents from 16th to 18th Century report the existence of Peyotism in Mexico and parts of United States of America.

Peyote religion developed during the 2nd half of the 19th Century and this was practised by voluntary religious organizations. When taken under proper conditions, peyote makes the worshippers to reach a mystical state. Under the influence of peyote, the person is able to foresee and predict events such as whether the enemy would attack on following day, or would weather remain fine, or who has stolen articles from somebody's house, and others of similar nature.

The morphology of the plant has a resemblance to the use it is put to. It appears to have a huge carrot-like body which remains below the ground, and only the button-like top is above-ground.

Peyote contains several very strong alkaloids with narcotic properties. The Government of USA has put a ban on the cultivation of this cactus.

The Fly Agaric

The name fly agaric is given to a group of deadly poisonous mushrooms. Mushrooms, as such, are a beautiful creation of nature.

They always attract a 'collector' because of their innumerable shape, size and colour. However, the more brilliantly-coloured they are, the more poisonous they are.

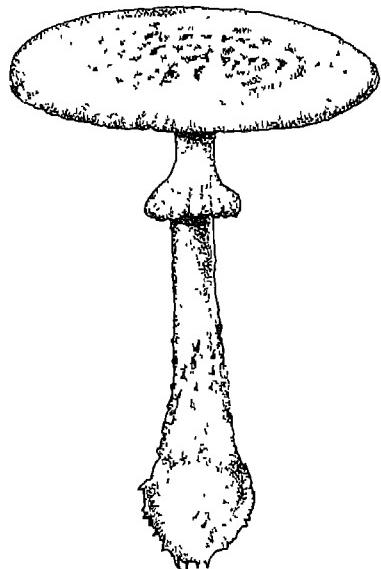


FIG. 9.3
Fly Agaric, *Amanita muscaria*,
this mushroom is deadly
poisonous

This beautiful fly agaric of red and orange hue is botanically known as *Amanita muscaria* (Fig. 9.3). This mushroom has been in use in Siberia for over 3,500 years. Dr Tylar noted that Oliver Goldsmith, 1762, reported that Siberian farmers were in the habit of drinking stewed *Amanita*; this broth intoxicates the user. As this mushroom is rare in the cold regions of northern Siberia, the tribals left no stone unturned to preserve the active principles. They learnt that the potency of the active principles is not lost even if it passes through the kidneys of three or four successive imbibers (Johri and Srivastava 1978).

When Lewis Carroll wrote *Alice in Wonderland*, about a hundred years later, the scientifically-minded author mentions that the vision of the users of this mushroom became distorted. The "Old Caterpillar" — A character in the above book — sits on a mushroom. He advises Alice to eat the toadstool from one end if she wished to grow dwarf, and from the opposite end if she wished to grow tall !

Amanita is a large genus of about 100 species of deadly poisonous

mushrooms. There are two species —*A. caésaria* and *A. rubescens* — which are edible. The fly-agaric (*Amanita muscaria*), variously known as 'Destroying angel' and 'Death cup', contains the alkaloids amanitin, ibotenic acid and muscarin. Amanitin affects liver and kidney. Muscarin is used in homoeopathic medicine for curing epilepsy. Two other deadly poisonous amanitas are: *A. verna* and *A. pantherina*. The consumption of *A. pantherina* causes kidney failure and instantaneous death.

Several species of *Amanita* are used by local inhabitants (in Mexico) as an intoxicant and in their 'secret' ceremonial rites. The consumption of the mushroom — after cleaning and passing it through burning incense — was accompanied by prayers before an alter (Johri and Srivastava 1978). The visions of unreality of various types are experienced by the participants.

Recently, people have become more interested in the above-mentioned mushroom since some scientists presume that *A. muscaria*, is the religious 'soma' plant of Hindu mythology. The 'elixir of immortality', the drink of the gods, 'soma' or 'somarasa', was probably a plant product. Based on ethnobotanical studies of Wasson, Schultes (1969) wrote": the identification of soma as *A. muscana* appears to be the first that satisfies the descriptive details".

Indian Hemp

Commonly known as 'Indian hemp', *Cannabis* is yet another hallucinogenic plant (Figs. 9.4, 9.5). This tall, robust, branching annual is a troublesome weed often growing on rubbish piles (around the human habitations) that are rich in organic nitrogen. It is a dioecious plant with hollow stem and palmately-compound leaves. The male flowers are borne in axillary or terminal, elongated drooping panicles, whereas the female flowers are arranged in short axillary spikes.



FIG. 9.4

Indian Hemp, *Cannabis sativa*, twig with leaves and male inflorescences. The hallucinogens 'bhang', 'charas', 'ganja', 'hashish' or 'marijuana' are obtained from female plants.

often used as an intoxicant. The hallucinogenic drug from *Cannabis* is mentioned in the Atharva-Veda (2,000-1,400 BC). Panini, the great grammarian, mentioned *Cannabis* flowers as 'bhang' and Sushruta (6-7th Century AD) described its medicinal value. Ancient Arabic and Persian literature also mention its use as an intoxicating drug. Various epithets have been suggested in earlier literature: 'Liberator of Sin', 'Delight Giver', 'The Heavenly Guide' and 'Soother of Grief' - all these describe the effect of its use.

The drug from *Cannabis* is the resin obtained from leaves, flowers, seeds and stems. It is the female plant that yields more resin than the male. The quantity of resin is much less in the plants raised in temperate countries.

Various methods are adopted for the collection of the resin.

The hemp plant is native of western and central Asia; now it is cultivated widely in both the temperate and tropical countries. A fertile, well-drained soil is suitable for its cultivation.

Its use as a drug is mentioned in a 'Chinese Herbal' dating back to 2737 BC, in our own ancient *Materia Medica*, and it is used even today in both Ayurvedic and Unani medicines. There is evidence that the Aryans, who migrated to India thousands of years ago, used the *Cannabis* fibre, and 'bhang' (prepared from its leaves) was

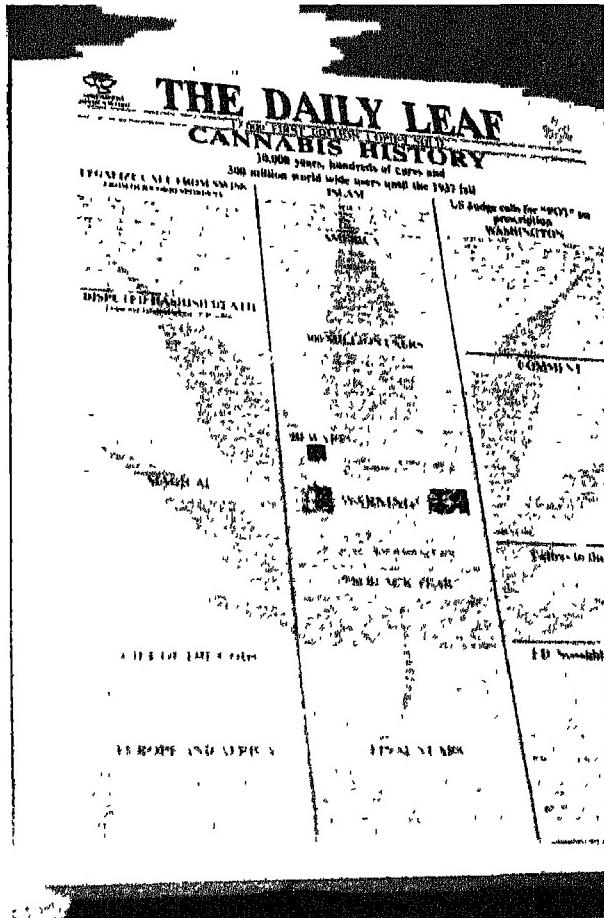


FIG. 9.5

Indian Hemp, *Cannabis sativa*, Variously named: 'magical', 'gifts of Gods', 'the daily leaf'; its use has been banned in many countries.

Sometimes, early in the morning, men dressed in leather-suits or jackets run through the field of *Cannabis*, rubbing and crushing against the plants. The resinous matter that sticks to the leather-suits is scraped off with the help of a sharp knife. In another method,

the flowering tops are carefully pressed between layers of cheese-cloth and then the resinous substance is scraped off. As a narcotic, *Cannabis* is either smoked or eaten, and is known by various names: 'bhang', 'charas' or 'ganja' in India, 'hashish' in Egypt and Asia Minor, 'kef' in northern Africa, and 'marijuana' or 'marihuana' in America.

'Bhang' is prepared from wild male as well as female plants. The young flowers, stems and leaves form the upper parts of the plants are used to prepare a decoction in water or milk. It is usually drunk, particularly during the Indian festival of "Holi" (the festival of colours). 'Ganja' is prepared by harvesting the tops of the selected cultivated female plants. This is usually smoked. 'Charas' is the unadulterated resin, a sticky yellowish exudation from the flowering tops of cultivated female plants. 'Majun' is another form of ganja that is mixed with sweetmeats.

The general effect of *Cannabis* consumption is a feeling of well-being, happiness and increased strength, often marked by uncontrollable laughter. The more immediate effects are reddening of the eyes, moderately rapid heart-beat, tightness of the chest (if the drug is smoked), thirst, cravings for sweet preparations, drowsiness, muscular in-coordination, and disruption of the preception of time and space. The feeling of well-being tempts the victim to repeat the drug followed by stronger dose. This leads to habit-formation and addiction. Under the influence of the drug, the user may sometimes be induced to commit murder and other such crimes. It is reported that the followers of Al-hasan-ibn al-sabbah, a sect of ruthless killers, the 'ashishins' (or 'haschashins' or 'haschischins') were drugged heavily with cannabis before sending them for the heinous crimes. The words 'assassin' and 'hashish' are derived from the name of this sect.

Acute and regular intoxication can induce visual hallucinations as would happen in a Kaleidoscopic play, anxiety, depression and extreme variation of mood. Chronic users are usually weak character with moral and mental deprivation.

The number of chemical compounds isolated from the resin are numerous: cannabinol, cannabidiol, cannabidiolic acid and many others. Amongst these Δ -tetrahydrocannabinol is the major psychoactive drug.

One good feature of this notorious plant is that it is a 'multipurpose' plant. Ramaseshan (1995) reports that *Cannabis* has many positive characters:

- It holds the soil and prevents soil erosion.
- The strong pliable fibers can be used for making sail-cloth, and also large-diameter ropes that are used in ships.
- Soft fibers from the plants — harvested at the time of pollination — give soft-textured cloth.
- The fiber is ideal for fiber-reinforced-plastic (FRP) composites.
- Hemp fiber contain quite a good proportion of amorphous silica, and they are almost like glass-fibers. They can be used to add strength and stiffness to plastic products.
- Hemp fiber is better than jute (*Corchorus* spp), kenaf (*Hibiscus cannabinus*), flax (*Linum usitatissimum*) and bagasse (*Saccharum officinarum*) for the manufacture of paper. High quality bond paper has been produced from 10% hemp fiber together with recycled paper pulp. This process is eco-friendly too, as chlorine bleach and acid treatment is not necessary.

The abuse of the drug has made many countries enforce ban on its cultivation. But after its beneficial effects became known,

attempts are being made to use genetic engineering to produce Δ -tetrahydrocannabinol-free plants.

Coca

Coca is a stimulant and narcotic obtained from the leaves of *Erythroxylon coca*. It is a habit-forming drug, known to have produced the highest number of addicts, more than any other such narcotic. Nearly fifteen million people in South America alone (mostly in Peru) are coca-addicts. Since pre-Inca-times the native American Indians of Peru, Chile and Bolivia use the coca leaves as a masticatory and think it to be a cure for many ailments. The leaves are mostly chewed, mixed with the alkaline ashes of certain plants, and powdered limestone. Chewing coca leaves enables the chewer to do incredibly strenuous work for long periods without any feeling of fatigue, hunger or thirst. The average consumption of coca leaves by an American



FIG. 9.6

Erythroxylon coca, leafy, branch with flowers and fruits; source of cocaine.

Indian is 20 to 50 gms per day. Many of them have distended cheeks because of the habit of retaining the chewed leaves (or cud) inside the mouth.

A native of Andean highlands, the coca plant (*Erythroxylon coca*) is an evergreen shrub or small tree (Fig. 9.6) and is grown extensively in many countries — Peru, Argentina, Bolivia, Colombia, and Brazil in South America, and Java, Sri Lanka, Taiwan and India, and to lesser extent in South Florida, California and Hawaii. In most countries its cultivation, production and sale is under official control.

Coca alongwith cola plant (*Cola acuminata*) forms the main ingredients of some soft drinks. These have been substituted by some other ingredients which provide as much stimulation and are without any harmful side-effect.

The crude drug 'cocaine' from the coca plant is a mixture of a number of alkaloids: cocaine, tropococaine, cinnamylcocaine, truxillines and benzoylecgonine. The last three alkaloids are inactive but can be converted easily to pharmacologically active cocaine.

Cocaine is a potent, dangerous and habit-forming drug causing various 'social problems'. It was isolated in 1860 in pure form. Its medical use is based on its ability to produce local anaesthetic effect especially of the mucous membrane of the eye, nose and throat. The first use of cocaine as a local anaesthesia was made in Vienna in 1884 by Carl Koller. Subsequently, it was the first amongst numerous drugs that have been used for anaesthesia. The same anaesthetic effect produced after chewing the leaves made the native American Indians unaware of any hunger and thirst. It is readily absorbed by the mucous membrane and has a highly toxic action upon the central nervous system. First, there is stimulation — a feeling of well-being, increased physical strength, and relief from fatigue. This is then followed by extreme depression and mental fatigue. Under such

conditions, the user is tempted to repeat the dose again and again to retain the feeling of well-being. This way one becomes addicted to this drug. Larger doses lead to stimulation of the spinal cord too, and convulsions may result. Hallucinations also accompany, and the user often gets frightened, seeing imaginary insects crawling on his body. Ultimately, death may result from respiratory failure.

The most hazardous situation in the use of cocaine is addiction, and this may develop within a very short time. If it is taken in the form of snuff and absorbed by the mucous membrane of nose, because of its irritation and vasco-constricting properties, ulceration in the nasal cavity may start.

Addiction becomes a social problem because the addicts prefer company and induce their friends to get the same feelings as they themselves have. In this way, a large group of addicts may assemble in one place. These people are often fearful and sometimes suffer from a paranoiac belief of being threatened and frightened. Because of this feeling, they often carry weapons and are likely to use them. Sleeplessness, loss of appetite, nausea and digestive disorders are the other effects of prolonged use of coca or cocaine. Mental deterioration may also result and many addicts end up in mental hospital.

A newspaper report (*The Statesman*, May 23, 1996) said that five hundred years after an Inca girl was sacrificed as a gift to the gods and left in a frozen tomb on a volcanic peak in the Andes, her mummy was brought for public viewing on Tuesday, the May, 21, 1996 at National Geographic Society, Washington. It is to be noted that this specimen of 'Ice Maiden' was surrounded by various offerings like figurines of gold, silver and shell, featherhead-dresses and garments that looked as good as new and, in addition, leaves of coca, the plant

that yields cocaine. To the Incas, Ampato was the mountain god who brought life-giving water and good harvests. In return, Ampato was gifted with the sacrifice of one of their near and dear ones — a cruel tribute. The leaves of Coca were probably kept so that the maiden never felt fatigue on her eternal journey.





Poisonous Plants

THE primitive man, as a 'food-gatherer', must have come across plants which had adverse effect, sometimes even killing them. He soon learnt to avoid such plants for food. Not only that, he also learnt to use such plants for procuring food for himself, and to do away with his enemies. But then why only certain plants/plant parts 'behaved' in this fashion? The reason is that these plants contained certain groups of chemicals or individual chemicals as a metabolic product which had toxic effect on human health. All such plants are poisonous. Even at present there are certain tribesmen (in different parts of the world) who procure their food mainly by hunting animals with bows and arrows (that are poisoned). To catch fish they use certain plants which stupify or kill them but do not have any ill-effect later on. This method of obtaining food has been practised by man from very ancient times. In fact the term 'toxicology' is traced from the Greek term 'toxicom' meaning poison. There are many mythological and historical legends that tell us about the use of plants as toxic material for killing. Ancient Hindu scriptures refer to many such incidences. Sushruta, in his work (Sushruta-Samhita, 800-1000 BC) described how the poisons were mixed with food and drink, anointing oils, perfumes, medicines, bathing water, snuff, or

sprinkled over clothes, beds, etc. or put in the ears or eyes. Jealousy, selfish motive, revenge and politics were the main causes for such poisonings. Even there were 'professional poisoners' who were hired for committing such crimes. These people learnt the art of concealing the bitter taste or unusual odour of the poison used. One of the shastras (*Medicine of the Hindus*), translated into English mentions: "It is necessary for the practitioner to have a knowledge of the symptoms of the different poisons and their antidotes, as the enemies of the king, bad women and ungrateful servants, mix poison with food". When the child of Rani Lakshmibai of Jhansi was poisoned by her enemies, the Vaid (physicians who practice Indian herbal medicines) did not know about the symptoms and antidote and the child had an untimely death. *Bhoja-prahandha* — a medical treatise written about 980 AD — mentions about poisons that produced loss of consciousness and a later recovery, and could be used in surgical operations. Even the use of 'dhatura' (*Datura spp.*) and 'bhang' (*Cannabis sativa*) in criminal practices, dates back to the remote past. 'Bhang' has been mentioned in the 'Atharva-Veda' also (2,500 BC). No doubt there has been abuse of plant poisons, but their usefulness was also recognised in ancient India. The earliest mention of medicinal uses of plants can be traced back to the 'Rig-Veda' (4,500-1,600 BC). The early treatises such as 'Ayur-Veda', 'Charaka-Samhita' and 'Sushruta-Samhita' deal with plants mainly in relation to medicine, agriculture and horticulture. The story goes that Bhikshu Atreya (of Buddhist period), a well-known professor at the University of Taxila, asked his pupil Jivaka to collect, identify and describe the properties of all the plants growing within a distance of 4 'Yojanas' (6 km) of the University. Jivaka later became the physician in the court of King Bimbisara.

There are many evidences to prove that the knowledge of the

people of ancient India in toxicology and related medical sciences was highly advanced and extensive.



FIG. 10.1

Poison hemlock, *Conium maculatum*, leafy branch with inflorescences and fruits. The juice from the leaves and fruits was given to the condemned persons in Greece.

The Greeks also knew several plant poisons but mostly used hemlock (*Conium maculatum*, Fig 10.1) for poisoning the condemned.

The modern methods of investigation of poisonous plant was started in the western countries. The father of modern toxicology is a french physiologist Orfila who after publishing his original work in 1814 became an authority on plant toxicology. Of late, the studies on poisonous plants have gained worldwide attention, mainly because of wide application of the active principles in medicine.

Hemlock

Many generations of young people knew about plant toxicology from a famous Greek legend that Prometheus brought fire to mortals in a

hemlock stalk for which the gods condemned him and punished him. Hemlock too was doomed to kill all mortal creatures who ate it. The plant became notorious as Socrates (470 BC-399 BC), the great Athenian philosopher, was put to death in 399 BC, at the age of 70. He differed with the views of the then important statesman in Athens, Anytus. The charges against him were of 'impiety' i.e. 'practice of religious novelties and corruption of the youth'. As a rule, at Athens, the condemned man 'drank the hemlock' and died within 24 hours. In the case of Socrates there was an unusual delay of one month because during the absence of the sacred ship sent yearly to Delas, no execution could take place. An escape was planned by his friend and well-wisher Crito but Socrates did not agree to make use of the facility to escape. The uncompromising and courageous upholder of justice drank the poison — juice of hemlock (*Conium maculatum*), cheerfully and allowed death to take over him.

Several cases of poisoning among children and livestock due to consumption of this plant are on record, although animals are not generally attracted to this malodorous plant. In New Zealand, death in dairy cows is most common. Once a circus elephant also died from hemlock poisoning (Connor, 1977). Children may mistake its leaves as those of parsley (*Petroselinum crispum*) and eat it or make whistles or peashooters from the hollow stems and thus get poisoned.

A reference to this plant has been made by Plato, Socrates and Pliny in their writings. Old men of the Greek Island of Coes were said to drink a cup of hemlock poison when they retired from their active life, and were of no further use to their country. The Anglo-Saxons used this plant in their medicines but now this use is restricted owing to the uncertainty of action.

Conium maculatum (Fig. 10.1), commonly called 'spotted hemlock' — because of its smooth, spotted stem — is a member of the carrot

family (Umbelliferae). It is much different from 'hemlock spruce', or *Tsuga* spp. which is a gymnosperm. The plant parts when bruised emit the smell of mice. All parts of the plant are poisonous and contain the alkaloids coniine, n-methyl coniine, conicéine and conhydrine. The fruits yield the maximal quantity of the alkaloids provided they are collected before they are fully ripe. The roots contain the least quantity of the alkaloids. Coniine is the first alkaloid to be produced synthetically. All the alkaloids are volatile liquids and are lost by slow drying or boiling.

The symptoms of hemlock poisoning are alike in all animals. Coniine and coniine hydrobromide have a direct sedation effect on the respiratory center. The eyes (pupils) become dilated, respiration rate increases, and there is difficulty in movement, particularly of the hind limbs. Death follows from respiratory failure or asphyxia.

The alkaloids are excreted by the lungs and kidneys, and the typical mouse-odour in breath and urine of a poisoned animal is diagnostic.

The North American 'water hemlock' or *Cicuta* is just as poisonous as *Conium* but has not spread so much as weed.

Nux-vomica

Nux-vomica is a well-known homaeopathic medicine against stomach-ailments of various types as a tonic and a stimulant. Actually, it is a poisonous drug obtained from the dried ripe seeds of *Strychnos nux-vomica* (Fig. 10.2 A-C) - a tree indigenous to most parts of India, and also Myanmar (Burma), Thailand, Indo-China and North Australia. It is a moderate - sized tree with a short, thick and often crooked stem, ovate, entire leaves and small greenish-white flowers in terminal corymbs. The fruit is a globose orange-red berry with 1 to 5 disc-shaped seeds. A number of alkaloids are present in the seeds; strychnine and brucine are important.

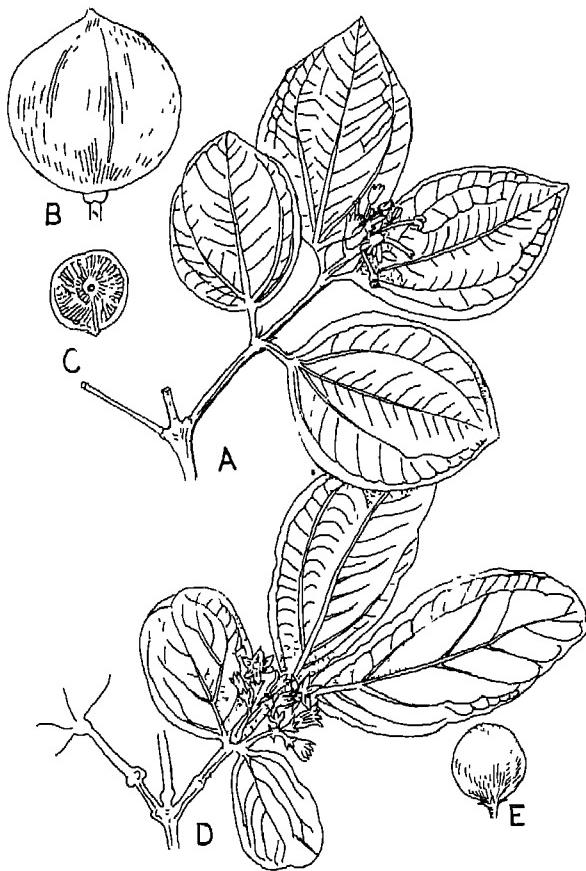


FIG 10.2 A-E

A Nux vomica, Strychnos nux-vomica. B Seed, the poisonous drug is obtained from the dried ripe seeds. D 'Clearing Nut tree', Strychnos potatorum, the black berry. E contains the seed which clear muddy water.

The alkaloid strychnine was discovered in 1818 from St. Ignatius's beans (*S. ignati*) of the Philippine Islands. Strychnine also occurs in *S. nux-vomica*, *S. colubrina* and *S. tieute*. Brucine is dimethoxy strychnine. Strychnine crystallizes from alcohol in colourless prisms

and is insoluble in water and soluble (with difficulty) in organic solvents. It is extremely bitter to taste, perceptible even in such dilute solutions as 1 part per 4 million, or 1 part per 1 million, depending upon the sensitivity of the person concerned.

In 1955, British pharmacopeia included strychnine hydrochloride and many other preparations of nux-vomica. Mixed with flour or starch, strychnine is largely used for killing rats, rabbits, etc., which destroy the crop in the fields. It is also used for killing the stray dogs. Widespread use of this dangerous drug has often resulted in accidental poisoning. Poisoning may sometimes occur from the deposit of the last few doses settled at the bottom of a bottle containing strychnine in the prescribed medicine. There is on record an unusual case where an infant, after breast-feeding, suffered from strychnine poisoning. It happened because the mother was given a medicinal dose of strychnine. She remained unaffected but the child was affected.

Strychnine rapidly enters blood — given orally or hypodermally — but it is less toxic when taken orally. It can be used in medicine because it is a strong poison in larger doses but a stimulant in very small doses.

There is one species — *S. potatorum* (Fig. 10.2 D) — which does not contain any alkaloid. It is popularly known as 'Clearing Nut' or 'Nirmali', has black berries (Fig 10.2E) with a few round compressed seeds. These seeds are used for clearing muddy water. The cut seeds are used by our villages for rubbing on the inside of the vessels, which are then filled with water. If, now, the water is allowed to stand for sometime, the impurities settle down at the bottom of the vessel and the water becomes potable. 'Clearing Nut' is a befitting name.

The drug strychnine is used for the treatment of nervous disorders

and paralysis, in very minute quantities. The alkaloids function as strong stimulants of the central nervous system, especially of the spinal cord. Strychnine has been used as an antidote of barbiturate poisoning or other depressants. Higher dosages of the drug can be harmful as it causes convulsions and, therefore, should be administered very carefully. In fact, its use in medicine is dangerous because of its varying potency and uncertain dosage. Strychnine came to prominence more as a plant poison than as a drug.

Curare

The aborigines tribal and people — in many countries — still use bows and arrows for killing animals and fish. Military expeditions into remote places — particularly in dense tropical jungles — have to be carried out very carefully lest they are attacked with poisoned arrows. All South American Indian arrow poisons are grouped under the name 'curare'.

These poisonous substances are prepared by mixing juices and resins of a variety of plants. Preparation of the poison is a closely guarded secret and ritual and handed down from one generation to the next, within the same family. The identity of all the plants used still remains incomplete. The leaves and stems of a few of these plants are known and they include: *Strychnos* spp. (of Longaniaceae), *Chonodendron tomentosum* and *Cocculus* sp. (Menispermaceae) and *Strophanthus* (Apocynaceae).

An aqueous extract prepared from the bark of some South American species of *Strychnos* — *S. toxifera*, *S. crevauxiana*, *S. castelnaei* and *S. tieute* — is the well-known highly toxic curare or 'woorali' arrow poison of the South American natives. The different kinds of curare poison are designated by the type of containers in which they are sold. The constituents of the drug vary in different containers.

'Calabash' (Gourd) curare contains the alkaloids curarine and curine, 'bamboo' (tube) curare from Amazon contains the alkaloids tubocurarine and curine; 'pot' or 'jar' curare contains the alkaloids protocurarine and protocurine.

The effect of curare poisoning is to paralyse the motor nerve-endings in the striped muscles. This may result in muscular twitching and untimely death due to respiratory failure. When introduced subcutaneously, it has a very quick action but when taken orally it is much less toxic due to its slow absorption and rapid destruction in the stomach. The use of *Strychnos* as a virulent arrow poison has been known since antiquity.

The story for the search of curare is very interesting. During the reign of Queen Elizabeth I, Sir Walter Raleigh had made a voyage to Guiana and published a book about his encounters in 1595. So, when in 1617, he was urged by King James I to set out for the search of 'El Dorado' — a city shining with gold (according to the natives of South America), he came to the same place that he visited earlier. However, he was not successful in finding El Dorado and lost his son's life in a war against the Spaniards while on this job. He was imprisoned and later killed because of his failure. But, the recorded accounts of his hair-raising explorations of these lands are most valuable. About the natives he encountered while traversing the course of Orinoco river, he mentioned: "These are valiant, or rather desperate people and have the strongest poison on their arrows ..". This was the first account of the 'flying death'. It is not that all the natives (American Indians) knew about it. Only their soothsayers and priests knew it and concealed the identity of the materials used and the procedures followed to prepare these poisons. Only a son could learn about it from his father.

The frail, slender, poison-tipped arrows, soundlessly flying through jungle, filled the victim with such a horror that the 'torment of death they inflicted' is an exaggerated statement. The real horror was in the painless suffocation induced by the arrow poison variously known as 'urare', 'curare', 'woorali', etc

It was an Englishman, Edward Bancroft, who (1769) could procure a list of ingredients used in the making of arrow poisons. These were : six parts of the root of 'Woorara', two parts of the bark of 'Warracobba coura', one part each of 'Cournapi', 'Baketi' and 'Hotchybaly'. But alas! no one knew these native names of the plants.

About 35 years later, Alexander von Humboldt gave an 'eye witness' account of curare preparation. An old Indian (American Indian) curare-maker, an obviously sophisticated beyond the practitioner of witchcraft, allowed him to sit through while he prepared the brew. A sample of the product was also handed over to him and yet he failed to learn what plants were used.

In 1830, Robert and Richard Schonburgk — the two brothers — made the next attempt. With the help of a native they befriended, the duo could reach the original location where the plants were growing. They did face much difficulty in reaching the spot. The plant used was a 'ligneous twinner' which wound itself like a snake from tree to tree and was known as 'Urari'. Although not in flowers, the fruits were available and the plant was identified to be a species of *Strychnos*.

In the next visit Robert Schonburgk was partially successful. He could bring back the bark used in 'Urari' poison, when at the last moment, the native backed out from preparing the poison in his presence. Fortunately for him, these native people were accustomed to kill only animals with arrow poison. Also, they could never think

that this man would extract the bark in water, concentrate it by boiling and use it on chickens to get the same result as that of an arrow poison.

Richard Schonburgk was luckier to be the first person to have the privilege of observing the whole process of preparation of arrow posion in 1840s. Various ingredients were pounded to a pulp in a wooden morter and pestle. This pulp was then boiled in water, keeping the heat at the same temperature for 24 hours. The extract was then poured in shallow pots for further evaporation and in the last was added powdered 'Maramu' root. The end product had a molasses-like consistency. By the third day the poison was ready. One important feature was that the person who prepared the poison had to follow a number of religious rituals, otherwise they believed that the resultant product could not be of any use. All they cared for was that the poison should kill quickly without making the slaughtered game unfit to eat.

So, this is the legend of romance, adventures and terror of arrow poisons, from the natives of South America. Not only that, an active curare chemical — d-tubocurarine obtained from the laboratory is life-saving drug too. A modern life-saving drug from the ancient 'terror of flying- death' is the net result.

Jimson Weed

Many solanaceous plants, e.g. *Datura stramonium* (Jimson Weed) and *Hyoscyamus niger* are poisonous, in the sense that the use of the narcotics produce an intoxicating effect to start with; prolonged use leads to disorders of the brain.

It was reported that once a man was continuously talking with someone when in reality there was no second person. The effected man's version was that he could see a well-dressed man with whom he was having conversation, although others could not see him. In

another incidence, a man found it difficult to drive his motor-cycle as he had a bizarre vision that the white lines drawn along the black roads were jumping up and down. These two men were not mental patients. As a matter of fact, both had the misfortune of swallowing datura seeds (by mistake).

Datura spp. are native of the tropics of both the New and the Old World. Even in pre-historic times its narcotic effect was known. This feature of datura has been gainfully used as well as abused, from time immemorial. Some archeologists presumed that the seeds of

datura were used as an anesthetic (in certain operations) by the ancient Peruvians. The ceremonial use of the seeds as a hallucinogen by the American Indians is well-known. It was assumed that those who used datura could foresee the future and discover buried treasure (Heiser 1969).



FIG. 10.3

Jimson weed, *Datura metel*, leafy twig with flowers and fruits.

In Indian mythology, Lord Shiva is associated with datura. Both flowers and fruit (of datura) are used in worship of Lord Shiva, particularly on 'Maha-Shiva Ratri' festival. At the same time there are also numerous reports of murders and suicides by consumption of its seeds. Even the leaves are intoxicating. A report says that,

during the second World War, a group of African soldiers lost their way in the jungles and being hungry and thirsty, they could not resist from eating the leaves of datura, mistaking it for a pot-herb. As a result, they got intoxicated and started abnormal behaviour.

According to yet another report, during 1960 and 1965, in Agra, the State Chemical Laboratory investigated 2,728 cases of datura-poisoning. Many-a-times the criminals offer some edible articles (mixed with datura seeds) to fellow passengers travelling in the same compartment of the train. When these passengers became unconscious, the criminals decamp with their belongings. Insanity and death are caused by the use of this plant. There is a controversial report of its use by certain tribes of American Indians to quieten unruly naughty children.

Although the plant is not a handsome one, its flowers are and it is adorned with numerous English names: 'Devil's Apple', 'Thorn Apple', 'Jimson Weed', 'Stink-weed' and 'Angel's Trumpet'. The sanskrit name 'Dhatura' is the source of the scientific name *Datura*. In old Indian literature, it is also referred to as 'Shivashekharā' because of its association with Lord Shiva.

Though a troublesome weed, and a poisonous plant as well, *Datura* is used medicinally too. Dried leaves, flowering tops and seeds are used as drug. The active principle is hyoscyamine — an alkaloid useful in bronchitis and asthma. The inhalation of smoke from burning leaves is also a good remedy for asthma (Jain 1968).



Plants with Stinging Hairs

MANY plants have epidermal hairs which are harmless. But, a few other plants have a special kind of hair to protect them from grazing animals. These hairs are the so-called 'stinging hairs,' as in many members of the nettle family (Urticaceae), such as *Urtica* spp. and *Laportia moroides*. The stinging hairs (of the nettles) are elongated, hollow cells with silicified tips that break off easily. The hairs can, therefore, prick the skin (of the victim), like a surgical needle, and inject the poisonous liquid into the skin. Stinging is caused by minute quantities of formic acid which (on entry into the skin) causes instant irritation.

The nettles (*Urtica* spp.) are herbs or shrubs of different height and with different degrees of poison. These plants grow in wastelands near human habitations, and neglected gardens. The leaves of the 'larger stinging nettle' (*U. dioica*), a perennial, are valuable as a source of chlorophyll, used in medicine, and the stems yield a very tough fibre (Hutchinson 1946). During the Middle Ages (14 to 16 centuries), the stinging nettle plant used to provide the fibres for the 'nettle' cloth.

'Tree nettle' or *Urtica ferox* is dangerous to both livestock as well as man. The brittle, pointed stinging hairs cause intense pain and can be fatal to animals and man alike. Horses have been known to die after entering a nettle-infested area (by mistake). First-reported death due to stinging-hair-poisoning of 'tree nettle' was in 1961, in New Zealand. Two men aged 18 and 21 years went out shooting in the afternoon of December 26, 1961. It was a warm afternoon and they wore light-clothing. On their return journey, in a hurry, probably, they passed through a 'jungle' of 'stinging nettles'. They felt as if there were a series of needle pricks. In less than an hour, one of them complained of stomach-ache and appeared exhausted. He was made to lie down to take rest and within a short time, partial paralysis set in; difficulty in breathing was followed by blindness. He was admitted to the hospital but died after five hours. His friend too, suffered similarly but to a lesser extent and could be ultimately saved.

The effects of 'tree nettle' stinging has been known for a long time and it is reported that there is inability to coordinate movement during the next few days. Similar incoordination problems were experienced by a group of trampers for up to three days (Conor 1977).

This much-branched shrub or small tree is 2 meters or more tall, with rigid stinging hairs up to 6 mm long, along the veins, margins and stalks of leaf. Margin of the leaves is coarsely toothed and each tooth ends in a long bristle. This plant is native to New Zealand.

The toxic substances include histamine, 5-hydroxytryptamine (serotonin) and acetylcholine. It has been shown that histamine with acetylcholine produces burning pain followed by itching, but neither compound alone produces the same effect. Though it is still unknown, it is expected that there are other toxic substances present in the nettle sting, in addition to those mentioned above. Material

with local anaesthetic activity and higher toxicity persists even when acetylcholine, 5-hydroxytryptamine, histamine and other extraneous chemicals have been removed from the extract of stings.

Urtica urentissima, a native of Timor, is so virulent that the effects last for months and may even cause death. It yields a strong fibre useful for weaving fine textiles (Hermann 1973).

Man is resourceful enough to make use of almost anything that grows on this earth. The urticas with stinging hairs have not prevented him from gathering the young tops of *U. urens* (small nettle) and *U. dioica* (common nettle) and eat them as a substitute of spinach. Their roots provide a yellow dye and their stem a fibre that could be used in place of flax to make fine linen (L. Milne and M. Milne 1967).

Laportia moroides, another member of the nettle family, is an inhabitant of Australia. It is grown in green-houses for its raspberry-like inflorescences. The stinging hairs of this plant are highly injurious. Gardeners usually wear gloves when they handle this plant.

Another species (*L. crenulata*), from the sub-montane forests of the Himalayas, is commonly known as 'Devil-nettle' or 'Fever-nettle'. So poisonous are the contents of its hairs, that a slight touch brings about severe irritation and pain all over the body which might even result in fever. The apex of the hairs of this plant are knob-like. When an animal brushes past the plant, the apical portion breaks easily pouring the acidic contents on the surface of the skin and this causes intense irritation.

Similar stinging hairs also occur on the fruits of the extensive climber *Mucuna prurita* (of Papilionaceae) and *Tragia* sp. (of Euphorbiaceae).

Mucuna pruriens, commonly known as 'cowitch', occurs almost all over the plains of India including Andaman and Nicobar Islands. It is a herbaceous twining annual with trifoliate leaves and purple flowers in axillary pendulous racemes. Curved, longitudinally ribbed, turgid pods are densely clothed with persistent, pale -brown or grey irritant bristles (during their ripening period). These bristly hairs cause intense itching on contact with skin and may sometimes cause blisters and dermatitis. Itching is caused by the presence of a histamine—liberating principle — a proteinase, 'mucunain'. The itching effect persists for 3 to 5 minutes. The hairs also contain 0.015% of 'serotonin' (5-hydroxytryptamine) and this is more effective as a cutaneous pain producer than histamine (Wealth of India). So long as the hairs remain on the fruit, they effectively 'guard' the fruit.



Potato

FROM time immemorial plants have stimulated human-beings to go for explorations and exploitations. There is one plant, however, which has been the cause of a large-scale human migration from one part of the globe to another, and this plant is potato (*Solanum tuberosum*).

Amongst the present food crops of the world, potato is one of the most important. We cannot think of a day without potato. But it was not always a hay-day for the 'Potatoes'.

A native of Peru and Bolivia (South America), the potato plant was discovered by the Spaniards on their first exploration of the South American continent. They took it home with them in 1570, after almost eight years from the discovery of the New World. From Spain the potato was later introduced into France, Germany and then Ireland. In the beginning there was tremendous opposition from every quarter and most people kept it at a distance. Even in 1765, one election was fought in England, under the slogan: "No Potatoes, no Popery." In 1774, the hungry Prussians sent back a consignment of the potato tubers just because "these things have neither smell, nor taste; not even the dogs will eat them, so what use are they to us". For a long time it was presumed to be something that was misfit for

the gentleman's taste. Some even thought it to be poisonous and did not feed it to the domestic animals.

The credit for prompting potato culture in Prussia goes to Frederick the Great (1712-1786). He saw to it that the seed-tubers were distributed free of cost, and made it compulsory for the farmers to grow them. Or else, their nose and ears would be chopped off.

Introduction of potatoes into France was because of the brain-wave of an apothecary named Antoine Parmentier (1727-1813). While in a prison in Germany, during the Seven Years' War (1756-1763) (between Austria and France on one side and Germany on the other), he was fed potatoes and did not find it unconsumable. On his return to France, he obtained a hundred acres of land from Louis XVI (1754-1793), the King of France at that time. On this land he started growing potatoes. This supposedly sandy waste was turned into a blooming garden of potato within a short time. One day Parmentier presented a bouquet of potato flowers (they are beautiful, no doubt!) to the King, who placed one flower in the buttonhole of his coat and passed on the rest to Queen Marie Antoinette (1755-1793). Prearranged or not, the Queen appeared in the evening with some of the flowers in her hair. Human nature is to imitate what the upper class people do. So, from the very next day, the courtiers started imitating their king and queen. This is one step to popularize potato. As the tubers started maturing, Parmentier arranged for an armed guard to protect his potato garden from the invaders, but the guard was removed during the night. This encouraged local people to dig out and steal the potatoes at night. Stolen things always taste better and they started liking the potatoes too. Soon, they took to cultivate it in their gardens too. It is said that after his death, potatoes were planted on his grave. It is interesting to note that in England also the peers set the example of eating

potatoes and then common people followed them. Soon vendors and hawkers were selling hot and baked potatoes on the streets of London.

In 1778 there was a war between Germany and Austria — called the 'Potato war' or 'Kartoffel Kreig'. Frederick the Great had invaded Bohemia and his army faced that of Austria. Frederick realised soon that his plan would not succeed as the Austrian army were in stronger position and there was shortage of food supply. Both the armies remained there and consumed the resources of the country, i.e. mainly potato. With the onset of winter both the armies were forced to evacuate Bohemia.

In a different incident, potato played the opposite role. Oliver Cromwell (1599-1658) waged a war against Ireland. Although his men entered the villages to destroy and loot the overland crops, the underground potato crop remained intact and provided great strength to the Irish peasants.

During the coming years, potato was so rapidly adopted by the poverty-stricken population of this country that within fifty years it became its staple food. Potato is an excellent source of starch and about seven pounds will supply a man's daily requirements of 3,000 calories, protein, iron and Vitamins B and C. Half the phosphorus and one-tenth of calcium requirements are also met with and the rest of a man's diet can be supplemented with milk. A vast majority of the working population, some 4 million or so, were entirely dependent on this crop. Whole generations of the Irish peasants grew up, lived, married and died without tasting meat. Such was the fame of the Irish potato.

In 1845 and 1846, Ireland's potato crop was hit by a fungal disease called 'Late Blight of Potato' (caused by *Phytophthora infestans*), and there was a terrible failure of the crop. Father Mathew, a Catholic

priest and one of the respected men in Ireland, wrote: "On 27th of the last month (July 1846) I passed from Cork to Dublin, and this doomed plant bloomed in all luxuriance of an abundant harvest. Returning on the third instant (August), I beheld with sorrow one wide waste of putrefying vegetation. In many places the wretched people were seated on the fences of their decaying gardens, wringing their hands and wailing bitterly the destruction that had left them foodless".

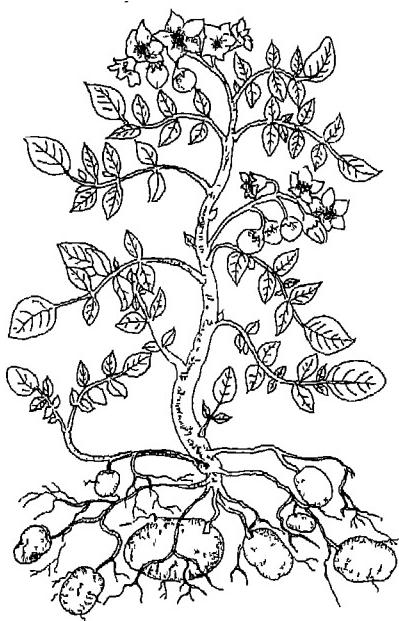


FIG. 12.1
Potato, *Solanum tuberosum*, a
flowering plant with the
underground tubers.

The real reason for the failure of the crop remained unknown. Some people believed it to be a curse for their sins; some others thought it was due to volcanic actions within the earth, and still others blamed the weather. In Ireland over a million persons died of starvation, and another million were forced to emigrate to other parts of the globe, particularly to the New World, by 1851.

It is an irony of fate that Lindley, the well-known editor of the periodical, "Gardner's Chronicle" of London, examined the diseased leaves under the microscope and could not recognise the fungus as the causal organism. He considered the fungus to be the excrescence from the diseased tissue. Correct diagnosis of the disease and the fungus responsible came much

later. The British government repealed the Corn Laws so that the foreign corn could be imported. But by the time the decisions were taken, it was too late. The emigrants carried with them a deep anger and bitter hatred against the British who they felt were responsible for the cruel misfortune that befell them in consequence of the potato famine.

The potato (*Solanum tuberosum*, Fig. 12.1) is an annual herb with underground stem tubers. The tubers are rich in starch and are consumed after baking, cooking or frying.



Plants of The Ramayana

"THE classical purity, clarity and simplicity of its style, the exquisite touches of true poetical feeling which it abounds,..... all entitle it to rank among the most beautiful compositions that have appeared at any period and in any country", says Monier Williams about the *Ramayana* written by the sage Valmiki. It is also compared with the great epic story of the occident — *Iliad* by Homer.

Many people, however, do not believe in the single authorship of the *Ramayana*. The main story was written probably during the period 400-200 B.C. by Valmiki, and later on several other authors contributed to the details without bringing about any change in the basic structure. Like most other poets, Valmiki too felt at home in nature's workshop, and drew abundantly from nature for his 'word-pictures'. Numerous plant names are woven in the lyrics in Adikavi Valmaki's *Ramayana*. A systematic study of this famous epic story would reveal the composition of forests in different geographical regions of the country during that period, distribution of trees and their flowering and fruiting seasons, and their utilization in daily life in those early days of Indian civilization. As the original work is

voluminous, we will discuss only some plants from different groups and try to bring out the fact that as of today, during the days of King Dasaratha, Rama, Lakshmana and Sita also the plants were useful and adorable.

Ornamental Plants

'Kamal' (syn. : 'pankaj', 'saroruha', 'barij', 'jalaj', 'ambuj') is the most prominent amongst the ornamentals. It is the sacred lotus of the Hindus and its use as offerings to different Gods and Goddesses is well-known. In *Ramayana*, the sight of lotus is compared to the pleasure of meeting an honest man. It is said that before Sri Rama set out for the great war with Ravana, he worshipped Goddess Durga with 108 lotus flowers to obtain her blessings. Even today this tradition is followed by making an offering of 108 lotus flowers to Goddess Durga on the day of Mahaashtami before Dussera (Vijayadashami). Throughout the text of *Ramayana*, lotus has been used as a comparison for eyes ('kamalnayan', 'barijnayan') or feet ('charankamal', 'padarvinda'). Sri Rama was handsome but not light-skinned ! His complexion has been said to be like that of 'shyam saroruha' i.e. blue lotus. However, the blue lotus appears to be of mythological origin or the poet's imagination. Lotus is botanically known as *Nelumbo nucifera* and details about it have been included in Chapter 8 of this book.

Another closely related plant, *Nymphaea* (see Chapter 8 for details) also finds mention in the text of the *Ramayana*. In shallow water these flowers in various colours — white, yellow, blue, red — look magnificent. Awe-inspiring Rama was compared to the sun and the subordinate kings to the small insignificant (when compared to the sun) flowers of *Nymphaea* ('kumud', 'kumudini', 'kairab', 'nalini').

In Aranyakanda, when Ravana abducted Sita, it has been said

that many plants, animals and birds were happy. They need not feel shy any longer as beautiful Sita was no more there. These plants were : 'Kundakali' — buds of *Jasminum multiflorum*, lotus, pomegranate — *Punica granatum*, and 'shreephal' — *Aegle marmelos*. The flowers of *J. multiflorum* are white and sweetly-scented.

To receive Rama and his bride, the whole city of Ayodhya was decorated with various kinds of flowers and trees: 'poogaphala' — *Areca catechu*, 'Kadali' — *Musa paradisiaca*, 'rasala' — *Mangifera indica*, 'vakul' — *Mimusops elengi*, 'kadamba' — *Anthocephalus cadamba*, and 'tamala' — *Garcinia xanthochymus*. Of these, 'vakul' with its small, starry, sweet-scented flowers and 'kadamb' with large, yellow, ball-like scented flowers are the ornamental trees. The later is a favourite tree of Lord Krishna too.

Ravana kept Sita imprisoned in 'Ashokvatika', i.e. a grove of Ashok trees in Lanka. A literal meaning of the word 'Ashok' is 'without sorrow'. That is why Sita used to implore "Oh, Ashok, why don't you take away my sorrow?" Ashok is *Saraca indica*, a medium-sized tree or shrub bearing bunches of dark-red flowers in the months of March-April. A Hindu belief still has it that the trees will flower only in places trodden by a woman's foot.

Other beautiful trees referred to in *Ramayana* are 'champaka' — *Michelia champaka*, 'kinshuka' — *Butea monosperma*, 'karnikar' — *Cassia fistula*, 'Parijata' — *Nyctanthes arbor-tristis*, 'mandar' — *Erythrina* sp., 'kovidar' — *Bauhinia* sp. and 'nagkesar' — *Mesua ferrea*.

Fruit Plants

It is said that the Rishis Jagyabalka and Bharadwaj had complete knowledge of the past, present and future as if it was a 'dhartiphala' in their hand — 'hastadhrita dhatrphala'. Dhatrphala or 'amla' is *Emblica officinalis*, a small, deciduous tree with smooth, greenish-

grey bark that peels off easily. The fruits are globose, fleshy and obscurely 6-lobed. The unripe fruit is green and changes to light-yellow when mature. It is sour and astringent and is occasionally eaten raw. It is the richest source of vitamin C. Amla fruit has been held in high esteem in indigenous medicine. Amla oil is reputed to promote hair growth. It is one of the constituents of the Ayurvedic medicine known as 'Triphala'; the other two constituents are 'haritaki' — *Terminalia chebula* and 'belleric myrobalan' — *T. bellirica*.

Another fruit tree which is often used on auspicious occasions is 'kadali' or banana, i.e. *Musa paradisiaca*. Its unripe fruits are used as a vegetable and is good for a tender stomach. The leaves are used as dinner plates in many parts of India; the leaf sheaths yield a fiber. More than half a century back, before the introduction of washing soap, many people burnt its stem to get an alkaline 'ash' for washing clothes.

In *Ramayana* a wealth of plant names are included in the Chapter entitled 'Pampavarnanam'. Around the lake Pampa were growing many types of trees such as 'champaka', 'vakula', 'kadamba', 'tarnala', 'patala' — *Sterospermum suaveolens*, 'panasa' — *Artocarpus integrifolia*, and 'rasala'. Amongst these, 'panasa' and 'rasala' are well-known fruit trees.

In Lankakanda, before the great war between Rama and Ravana started, Ravana said: "Oh Rama, since you have killed so many of my relatives, my sons and my brothers, I take an oath to slain you; so Rama, you flee for your life". In reply Rama said: 'Men are of three types — like 'patala' (*Sterospermum suaveolens*), 'rasala' (*Mangifera indica*) and 'panasa' (*Artocarpus intergrifolia*). The first only flowers, the second flowers as well as fruits, and the third only fruits. Similarly, some people merely talk, some do both, talking and acting, while still others only act without talking. One should be of the last category".

He was referring to the hidden flowers of *Artocarpus* as also in *Ficus* or Fig.

'Rasala' is *Mangifera indica*', one of the oldest and most important fruits of India and South-east Asia. It has been cultivated for nearly 6,000 years. It is a beautiful evergreen tree with thick canopy, paniculate fragrant flowers and drupaceous fruits. The leaves are regarded as auspicious. 'Amrapallav' or a small twig of mango tree with five to seven leaves is essential in almost all 'poojas' and other religious observances. When a new house is built, buntins of mango leaves are fastened over the doorways.

Many other fruit trees like 'jambu' (*Syzygium cumunii*), 'darimba' (*Punica granatum*), 'Shreephal' or 'bilva' (*Aegle marmelos*) and others find mention in the text of *Ramayana*.

Dyes

Among this group are mentioned 'haridra' -*curcuma longa* and 'kinshuka'- *Butea monosperma*.

When Rama was coming back to Ayodhya after his marriage with Sita, the 'Queen mothers' at home were preparing to welcome the bridal couple with 'haridra', 'doob' - *Cynodon dactylon*, 'pallav' - mango leaves, 'paan' - *Piper betle*, 'supari' - *Areca catechu*, 'dhanya' - *Oryza sativa*, and 'tulsi' - *Ocimum sanctum*. The robust perennial herb, *Curcuma longa* bears a number of primary, secondary or even tertiary rhizomes. The rhizomes are rough, hard and have numerous encircling ridge-like rings. The fine yellow powder obtained by grinding these orange-yellow rhizomes combines the properties of a spice and a brilliant yellow dye stuff (Kochhar 1981). The turmeric powder mixed with a little mustard oil makes a paste which is used in many auspicious occasions of the Hindus, particularly at the

marriages. The newly weds are blessed with yellow rice which is obtained by pounding rice grains with dry rhizomes of 'haridra'.

In Lankakanda of *Ramayana*, during the battle Lakshmana (Rama's second brother) and Meghnada (Ravana's son) were so much blood-stained that they were compared with two flowering trees of 'kinshuka'. *Butea* [after John Stuart (1713-1792), the Earl of Bute] *monosperma* (because of single-seeded fruits) is a deciduous tree with a crooked trunk and twisted irregular branches. When it flowers from January-February to March-April, it is leafless and it certainly looks one of the most magnificent trees with the whole crown coloured bright orange to vermillion. Truly, it appears to be a tree aflame. A yellow dye is made from an infusion of the flower petals. It is not permanent and is used during the festival of Holi. The three leaflets of the trifoliate leaf are symbolic of the 'Trimurti' — Brahma, Vishnu and Maheshwara. The leaflets are used as platters after stitching them together with the thin stem or runners of a particular grass.

Essential Oils

The King Dasharatha could not survive long after Rama's departure for his fourteen years exile. When he died, the funeral pyre was made with the wood of 'chandan' or sandalwood - *Santalum album*. Till today this practice is being continued in many parts of India although sandalwood has now become a threatened plant.

Sandalwood paste is an essential item in bridal decorations, in many 'poojas' and other religious observances, and also has a medicinal use. Its application on the forehead relieves one from headaches and fatigue. Sandalwood paste is obtained by rubbing a piece of wood on a rough stone surface with a few drops of water.

Another product with essence frequently mentioned in the text

of *Ramayana* is 'agaru'. 'Agaru' is regarded as a pathological product formed as a result of a fungal disease of *Aquilaria agallocha* — a large evergreen tree. The fungus belongs to Fungi Imperfecti. The infected plants have patches of fragrant resinous wood and this is 'agaru'. It has been prized from remote past in Egypt, Arabia, and throughout the East for its use as incense. It has also been used for making beads, rosaries and ornaments.

Oil seeds

'Tila' is one of the oil seeds which is also used in religious ceremonies. After the death of any person in the family an offering of 'tila' is made known as 'Tilanjali' or 'Til tarpan'. In Ayodhyakanda it is mentioned that after the death of King Dasharatha, his third son Bharat offered 'tilanjali', according to the Hindu rites. 'Tila', *Sesamum indicum*, is the source of vegetable oil — sesame oil or gingelly oil. The plants are erect, bushy annuals up to 2.0 m in height with a longitudinally furrowed and densely-hairy stem (Kochhar 1981). Although the lower leaves are lobed, the upper leaves at the region of the flowers are lanceolate. The hanging flowers are borne singly or 2 or 3 together in the axil of the leaves and are of various colours: white, mauve or pink. Often, the flowers have been compared with the nose of the human beings (in shape). The small compressed, black, brown or white seeds are rich in oil.

Other Important Trees

As mentioned in the beginning, numerous trees have been mentioned in the text of *Ramayana*. From the description of different geographical regions as written under different 'kandas' -- Ayodhyakanda; Aranyakanda, Lankakanda, the profusion of trees growing in these areas can be understood.

A very beautiful description of 'vata' or 'nyagrodh' is given in Ayodhyakanda. It is the largest of all trees. It has a very thick canopy, its leaves look bluish and the fruits are red. A firm belief in religion is said to be as strong and firm as 'vatavriksha'. The plant is botanically known as *Ficus benghalensis*.

Opinions differ about the exact location of 'Panchavati' where Rama spent part of his period of exile. Some consider it to be near the present-day Nasik, some others claim it to be in the district Bidar in Madhya Pradesh. Although the name Panchavati suggests it to be a forest composed of five different types of trees: *Ficus religiosa*, *F. benghalensis*, *Aegle marmelos*, *Emblica officinalis* and *Saraca indica*; the varieties of trees/plants undoubtedly exceeded five. According to a different author of *Ramayana* — Krittibasa (written in Bengali), the two main trees of Panchavati are 'madhhca'- *Mauca latifolia* and 'nyagrodh' - *F. benghalensis*. Some authors, however, include *Shorea robusta* - 'Sal', *Borsassus flabellifer* - 'Taal' or 'Toddy', *Garcinia xanthochymus* - 'Tamala', *Artocarpus integrifolia* - 'Panasa', *Mangifera indica* - 'Rasala' and *Santalum album* - 'Chandan'.

'Kapas' is mentioned in Balakanda, where it has been said that the character of a good man is like the fruits of 'Kapas' - *Gossypium* spp. These are dry and without taste but they are so valuable.

Like this, in the entire *Ramayana*, numerous plant names are mentioned — sometimes in description of an area or sometimes in comparison with human beings, and their different organs. Even if we intend to, it will be difficult to incorporate the long list of the names from *Ramayana* in this article. Only a bird's eye-view of the vegetation of *Ramayana* (period) has been presented here.



The Wonderful World of Cacti

IT is a thrill to behold a collection of cacti and succulents, some with their majestic size and bizarre shape, and some others with their beautiful flowers. The members of the Cactus family (Cactaceae) belong exclusively to America. It is a large continent with varied type of climatic conditions and, therefore, many of the cacti grow in diverse types of climate and different growing conditions. Majority of them occur in south-western states of North America, and Mexico, and the mountains and grassland regions of South America. There is only one cactus, *Rhipsalis*, which is reported from Africa, Burma and Sri Lanka. It is not known how this genus reached these parts of the globe. It may be assumed that the seeds were carried across the Atlantic by pre-historic birds.

Cacti appeared during the Eocene period, about 50 to 60 million years ago. Plants that were growing in tropical South America during this period faced the continuously deteriorating climatic condition. General decrease in rainfall and the scorching heat of the sun induced

the plants of this part of the world to develop some adaptive measures so that they could store some water in their stems. This made it possible for them to withstand the drought periods. These predecessors of cacti, therefore, did not differ much from other plants growing around in the same locality, and the changes to make them more adaptive to their surroundings developed gradually. *Pereskia* (Fig. 14.1A) (and other members of the group Pereskioideae) is one genus that resembles the ancestral cacti and can be considered as the predecessor of the modern succulent cacti (Slaba 1992).

The cacti have been able to adapt themselves to the climatic changes since then, and presently grow over a wide range of habitats. There is one important feature common to all of them — that is, they can survive only on well-drained soil. Although generally the cacti are regarded as desert plants, they can also grow on the arid Prairie lands, the snow-covered slopes of Superstition mountains (Arizona), the rain-soaked forests of Central and South America, or the grasslands of Argentina. Another fascinating feature of all cacti is how they can 'drink' every drop of moisture (in the form of rain) that comes their way, and how they store this water economically through the prolonged drought periods till it rains again. Many of these cacti have various modifications and adaptations to counter these difficulties.

The cacti are of many different types. Majority (of them) are long and lanky, with or without branches. Some are spherical (round) or flattened as in mammillarias and opuntias. They often carry a large



FIG 14.1A

A collection of Home-grown Cacti

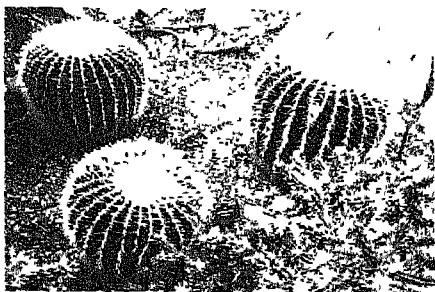


FIG. 14.1B

Three large specimens of *Echinocactus grusonii*, photographed at Royal Botanic Gardens, Kew, London.

Familiar and most ornamental amongst all the globose cacti. It was discovered in Mexico in 1889. Numerous specimens of this cactus have been exported mostly to the southern USA where it is commonly known as "golden' barrels". At present *Echinocactus grusonii* has dwindled in number being distributed only sparsely in the

number of spines, e.g. in *Opuntia tunicata* the large spines have a curved fish-hook-type end. *Echinocactus grusonii* (Figs. 14.1A,B, 14.4H), popularly called 'coussins de la belle-mére' in France, is usually dedicated to the mothers-in-law, as the dangerously curved spines would make it terribly rough seat for her! It is the most

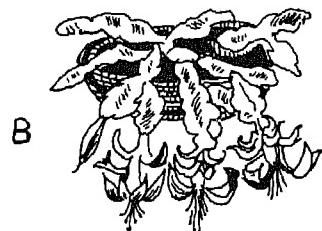
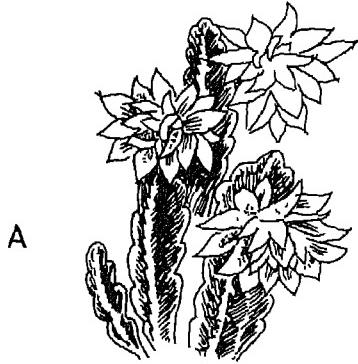


FIG 14.2 A,B

A *Epiphyllum*, the orchid cactus, with beautiful night-blooming flowers.
B *Zygocactus*, 'Christmas Cactus'. Note the flattened dichotomously-branched stems.

Rio Moctezuma river system. The river forms 500 to 1,000 m (1,600-3,300 ft) deep canyons where the climatic conditions are more humid and warm than the surrounding areas. Currently, investigations have shown that its population density has gone below critical limit. The plant is about to become extinct at least in its homeland. The reason is not only random collection and export but also the infection by insect pests, particularly the snout-beetles whose larvae feed on its fruits and seeds (Slaba 1992).

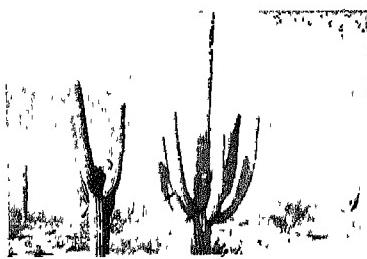


FIG 14.3

Saguaros, the sentinels of desert — *Cereus gigantea*.

There is another group of cacti, which are all very tall plants and often 200 to 300 years (or more) old. To this group belong the Saguaros (Fig. 14.3) and Cerei.

Another group of cacti look more like a fleshy succulent plant, e.g. *Ariocarpus* with a rosette which appears to be without spines until one looks through a microscope. The Pereskias (Fig. 14.4A) are the only cacti with small green leaves — a luxury for them. These occur mostly in the moist forests of Mexico and Central America, and the scrub forest of Brazil.

Some of the well-known cacti are:

(a) ***Opuntia***. Commonly referred to as 'Prickly Pear', *Opuntia* spp. (Fig. 14.4E,F) are one of the best-known cacti. It is supposed to be in existence for 50 million years — as supported by fossil record (O. Leese

and M. Leese 1959). Originating in Mexico, it has about 300 species and is worldwide in distribution. It is propagated easily, both vegetatively with the help of the green, flat, pad-like bodies, and by seeds. Opuntias are sometimes used as hedges in many different countries of the world. In Spain these plants encircle the farms used to breed the bulls for bull-fights. In Israel, *Opuntia* hedges are used as part of their frontier defences in areas which would otherwise be indefensible. Such hedges are so tough that they are impenetrable by man, animal or even convoys. In India also hedges of opuntias demarcate the farm areas.

In Australia imported opuntias provided a cheap and safe hedge before the days of barbed wire. *O. inermis*, native of tropical America, spread rapidly to cover large stretches of land within a short spell of time. So much so that to control this invasion, a moth (*Cactoblastis cactorum*, cochinal insect) had to be introduced. The voracious caterpillars of this moth actually blasted out the opuntias out of Australia.

The fruits are edible after removing the small spines — a delicacy especially for the people of Latin America. Some Mexican people use the tender young pads — called 'los nopalitos' — as food.

One type of *Opuntia* with cylindrical joints is known as the 'chollas'. The name 'cholla' is of Spanish origin meaning head-shaped. Often, the crown formed by branches and joints is shaped like a human head. These trees may grow up to twelve feet (or more) height; its branches are rounded and have joints which are linked like sausages. In some species the joints are covered with glittering gold and silver spines — a sight to be admired only from a respectful distance. These joints or 'nobbins' (as they are named in America), fall off easily from the mother plant and grow into new plants. They are easily dispersed by cattle and other animals to different places where new colonies

may start. Sometimes the field rats and squirrels carry away these 'nobbins' to fence the path leading to their nests or their usual feeding ground. It has been noticed that sometimes they pile up these prickly joints to make a wall four feet high and five feet across with a tiny entrance for the rats only around their nests. It is almost like a well-protected fort. It is said that rat population is highest in areas with a large number of 'Chollas' and Prickly Pears.

Certain birds also make their nests in the 'Chollas' for protection. The 'road-runners' or 'paisano' — a bird from Texas — is said to use these 'nobbins' in their fight with the rattlesnake. As the story goes: once a rattlesnake was found asleep by a 'Paisano' bird. It carried the joints of Cholla cactus in its beak one by one to make a wall around the coiled-up snake and lastly dropped one 'nobbin' on it. The snake woke up and as he moved, the 'nobbins' got attached all over his body. The more he tried to get rid of the spines, the more he was entangled. Finally, as the snake became tired, the bird did not have any difficulty to kill it (O. Leese and M. Leese 1959).

A Brotherhood in New Mexico — the Los Hermanos/Penitentes — used to inflict self-torture in a religious ceremony, by embracing a bunch of "Cholla cactus".

The 'Cholla' cacti have many fascinating names such as the 'Staghorn', the 'Cane', the 'Chain', the 'Jumping Chollas', and the 'Teddy Bear Cholla'. Usually all of them bear beautiful flowers of various colours.

(b) **Orchid Cacti.** The Orchid cacti, or Forest cacti, grow in a very different habitat, usually in the dense tropical forests of Central and South America. The struggle for survival has turned them into epiphytic cacti — they climb high into the trees for availability of sunlight. Their roots grow in the 'pockets' of humus on the tree

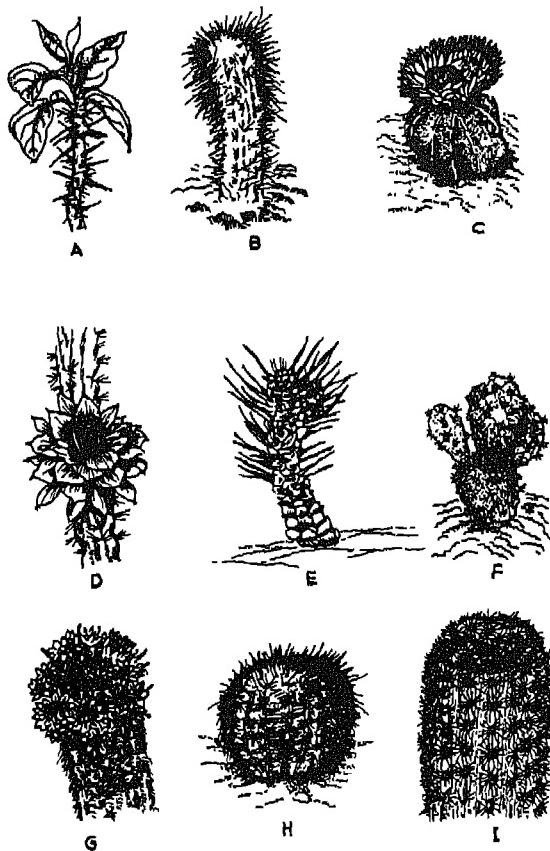


FIG 14.4

A *Pereskia godseffiana*, the leafy cactus. B *Cephalocereus senilis*, the 'Old man' cactus. C *Astrophytum myriostigma*, with the star-like appearance. D *Heliocereus speciosus*, its day-blooming flowers are fragrant. E *Opuntia diademata*, the easily cultivated 'Prickly Pear'. F *O microdasys* has light-green pads with white dots. G *Mammillaria microcarpa*, the 'Pin-cushion' cacti. H *Echinocactus grusonii*, or the 'Golden Barrels'. I *Echinocereus pectinatus*, with cylindrical, ribbed stem.

trunk. These are the Epiphyllums (Fig. 14.2A) — more or less succulent and perennial plants with jointed branches and superb white flowers. To the same group belongs the 'Christmas Cactus' or *Zygocactus*. The curiously jointed stems are flattened and dichotomously branched (Fig. 14.2B). Flowers scarlet or white, are borne terminally and the floral tube is curved upwards.

In 1812 Haworth (an English Botanist) named the Orchid cacti as *Epiphyllum* (from the Greek word meaning 'upon the leaf') species although the original name given by Linnaeus was *Cactus phyllanthus*. In 1831 Link coined the name *Phyllocactus* (also from the Greek word 'phylum' — the leaf). In 1923 Britton and Rose, however, retained the name *Epiphyllum* spp. Numerous hybrids between *Epiphyllum* and other cacti like *Heliocephalus speciosus* (Fig. 14.4D) have been produced. They bear beautiful flowers of a whole range of colours from yellowish-white and rose-shades to orange and deep-amber.

(c) **Mammillaria.** The Mammillarias, or Pincushion cacti, are another interesting group which include genera like *Corypanthus*, *Mammillaria* (Fig. 14.4G), *Neobesseyia*, *Escobaria*, *Neolloydia* and *Thelocactus*. Some of them are reported from Mexico and others from Venezuela. *Corypanthus vivipara* is commonly known as 'rising biscuits' as their stems usually become flattened in winter, because of dehydration. After the rains they swell up into small globe - like structures.

(d) **Saguaro.** Old Saguaro or the 'Giant Cactus of Arizona' (Fig. 14.3) is botanically known as *Carnegiea gigantea*. It grows in California and Mexico. These are the most majestic and awe-inspiring of all cacti — each one looking like a huge sentinel — often 30 to 50 ft tall. A large number of branches radiate on all sides from the main trunk much above the ground level. Sometimes these

branches attain fantastic shapes and turn the plants into the 'Lords' or 'Monarchs' of the desert. The Saguaros are usually jealous of any intruder into their own water zone. That is why it is a rare sight to see a young cactus growing within the area covered by the roots of an older plant.

There are two interesting colonies of Saguaro in Tucson (USA):

One, the Saguaro National Monument, an area of 53,000 acres, a few miles away from the city.

Another, a few miles beyond the Desert Museum.

The tallest and oldest known Saguaros occur in Saguaro National Monument. Some of these are 400 to 500 years old, often riddled with holes made by birds and rats for their nests. These magnificent plants, however, are becoming infected by the larvae of a moth. If the disease is not controlled, the Saguaros may be completely wiped off the surface of the earth.

The second colony is of comparatively younger plants and is still safe from the moth. As the wood retains its natural appearance, the Pima Indians use the woody ribs of Saguaro plants for making furniture.

(e) **Cereus**. The *Cereus* cactus is also known as 'Torch thistle'. These cacti are usually with erect, succulent stem, generally branched and ribbed; spines are of common occurrence but long hairs do not occur. *Cephalocereus senilis* (Fig. 14.4B), one of the popularly cultivated species is commonly known as the 'Old man' because of the woolly head. The night-blooming flowers are borne amongst this mass of woolly head. *Echinocereus* (Fig 14.4I) is another genus of this group with cylindrical, ribbed stem, grows solitary or in clumps. Flowers are borne along the sides of the stem (not from the apex) and are usually large and of various colours — scarlet, crimson or purple. These are day-blooming.

Helicereus speciosus (Fig 14.4D), the 'Sun Cereus', has a weak prostrate, 3- or 4-angled stem with short spines. Its flowers bloom during daytime, are large, red and fragrant. Many others of the *Cereus* group are night-bloomers. *Selenicereus grandiflorus* from West Indies, known as 'King of the Night' has fragrant flowers often ten inches in diameter. *S macdonaldiae* from Uruguay and Argentina, the 'Queen of the Night', produces the largest flowers — 13 inches in diameter. These plants have climbing vine-like stems.

Aporocactus flagelliformis (also of *Cerei*) is the well-known 'Rat's Tail' cactus. Its long, soft (as it is covered with very fine spines),



FIG. 14.5
Lophophora williamsii, the mescal button or peyote.

pendant stem is cylindrical and gives the appearance of a rat's tail. Pink or red flowers bloom during daytime.

Astrophytum myriostigma (Fig. 14.4C) so called because of its star-like appearance, is a near relative of the *Echinocactus* (Fig. 14.4H). The plant body is short, almost globular, normally five-ribbed and the ribs are very broad and covered with tiny white scales. Large yellow flowers with red centre are borne at the flattened top. It is commonly known as 'Bishop's Hat'.

Mescal Button or Peyote are the species of *Lophophora*. The hallucinogen from this most famous and controversial cactus *L. williamsii* (Fig. 14.5), was used by the local inhabitants (Mexican) in their religious rituals from time immemorial.

It was first described for the Europeans by Hernandez, a physician sent by Philip II of Spain in 1570 to study the resources of 'New Spain', or Mexico. The hallucinogenic properties of this cactus have been discussed in detail in Chapter 9 of this book.

With many people, the collection of cacti is a hobby. The German Cactus Society, Deutsche-Kakteengesellschaft, was founded in 1892. This and other Cactus Societies publish quarterly journals to bring out the new and interesting news of the World of Cactus.



The 'Divine' Plant: Tobacco

"Tobacco, that outlandish weed,
It spends the brain and spoils the seed.
It dulls the spirit, it dims the sight,
It robs a woman of her right."

— Anonymous

THE opinion about the tobacco plant (Fig. 15.1) has been that it is a filthy weed, or a 'divine' plant. Some enthusiasts consider it to be a gift of the New World to the Old World, alongwith maize, rubber, potato and capsicum. Some others consider the tobacco plant to be the American Indian's revenge — or a curse — from the New World to the Old World.

How long the American Indians were in the habit of using tobacco — before the discovery of America in 1492 — is uncertain. Probably its use was known to them (American Indians) even before men took to agriculture. The wild species of tobacco are widely distributed in South America, Mexico, West Indies and Texas. Even its narcotic property became known to man probably by accident, while

he experimented with all the plants around him. He might have tasted the raw leaf (the uncured leaf does not have the required properties), or he might have enjoyed the 'pleasure' after inhaling the smoke, when he burnt the dry leaves. It is a fact that tobacco was being used all over America at the time of its discovery. Two species were cultivated quite widely and some wild species were used in western North America.

The tobacco was considered to be a 'divine' plant with the 'power' of treating various types of illnesses, and even against evil spirits. Its main use, however, was ceremonial. Columbus and his retinue noticed that the natives on the Island of Tobago used tobacco leaves in the form of hand-made cigars, snuff and chewing material. To what extent it was for recreation, is not known. According to some anthropologists, the American Indians learnt the use of tobacco for recreation, or pleasure, from the Europeans who learnt about the tobacco plant from the American Indians (Heiser Jr. 1969). The Indians knew the various methods of using tobacco : pipes were used in Mexico and North America, cigars were consumed by the natives of Caribbean Islands and northern South America, snuff was used in some areas, cigarettes — made by using tubes of corn husks stuffed with tobacco leaf powder — were smoked, the leaves were chewed and in some areas the resinous material was licked from the leaf. In some tribes only the members of a family were permitted to use tobacco, and in some families even women smoked tobacco.

The origin of the word tobacco is confusing. Once it was suggested to have been derived from the name of the Island Tobago or Tabasco. This concept was discarded afterwards. The word 'tobacco' was used in the writings of Oviedo (in the early 16th Century) on the plants of the New World. Probably the word 'tobacco' originally referred to the plant itself. But, according to some others it referred to the hollow

forked reeds used by the natives of Hispaniola for inhaling the smoke. There were other names also : 'petum' in Brazil, 'picietl' in Mexico, and 'saire' in Peru. These and many other names were soon replaced by 'tobacco'.

Although 'tobacco' was a well-known plant for smoking (for pleasure), it received the importance as a medicinal plant in Europe. The reason may be its resemblance to the Medicinal plant *Hyoscyamus niger* or henbane, or it may be that during the sixteenth century men suffered from many diseases for which cures were not known, and people were ready to try anything new as a remedy.

Tobacco was introduced into Spain in 1558, by a Spanish physician, and from Spain it spread to southern Europe and the Middle East. Jean Nicot — the French ambassador to Portugal — took the seeds of the tobacco plant to France in 1560. He was attracted to the supposed medicinal value of the plant, and soon the plant became known as the 'Ambassador's Herb', or 'Nicotiana' — a name that was later adopted by Linnaeus for this exotic plant. Thus Jean Nicot's name became permanently attached to this plant. Some people do not feel very happy about it because the species introduced by Nicot was *Nicotiana rustica*, an inferior taxon. Jean Andre Thevet had introduced the other species *Nicotiana tabaccum* three years earlier and accordingly the plant should have been named after Thevet. (Linnaeus named a different genus after Thevet — '*Thevetia*').

The English began growing tobacco soon after its introduction but the amount produced was not sufficient. This deficiency encouraged the Spanish traders to make money as their crop was growing in the American colonies.

The English colonists at Virginia (USA) tried growing tobacco. But the species grown in the eastern parts of North America was

inferior of the two, *N. rustica*. However, around 1610 or so, John Rolfe, an Englishman, managed to get some seeds of the superior species, *N. tabaccum*, from the Spanish colonies. Thereafter, there was no looking back and the production of tobacco in Virginia kept increasing year after year, so much so that in 1682 the surplus crop had to be ploughed down.

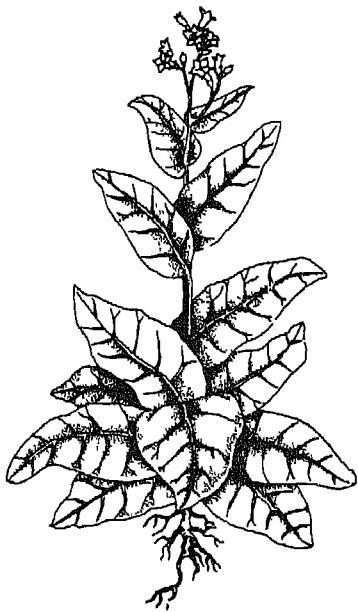


FIG. 15 1

Tobacco, *Nicotiana tabaccum*, a course (or a gift) from the New World A flowering plant

Virginia was 'tobacco-mad' and the country started depending almost on a single crop. The cultivation of tobacco was not encouraged by the mother country, as people started realising that there was no future of this crop. By the end of the 17th century it became such an important crop that it became a legal tender in Virginia. Wives were bought for 120 pounds (lb) of the leaf; ministers were also paid the same way. Many famous Americans were connected with tobacco. Both George Washington and Thomas Jefferson were tobacco growers. Patrick Henry defended the case of the colonists against the crown and became famous as a lawyer when he won the suit over the right to use currency instead of tobacco for payment of debts.

Carolina (USA) and Maryland (USA) also became important tobacco-cultivators, and Maryland became well-known for its shade-grown wrapper leaves for cigars. In the later-half of the 18th century,

Tennessee and Kentucky also started the cultivation of tobacco.

There are many different ways to use tobacco. Cigars are highly popular with the Spanish, whereas the pipe interested the English. Sir Walter Raleigh, Sir Francis Drake and Sir James Hawkins have all been held responsible for introduction of pipe-smoking in England (although, some un-named seaman should have got the credit). Smoking became so popular particularly after the Victorian period, that all those who could afford, took to it. Many did not approve of it also, the King himself being one of them. Pamphlets were issued speaking against the use of tobacco :

"A custom loathsome to the eyes, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black stinking fumes there of....." It is supposed to have been written by King James I himself.

Royal opposition became common in other parts of the world too. Torture and beheading was the punishment for those who imported tobacco in China. In the Near East, consumption of tobacco was prohibited on the basis that it was injurious to health.

Today, tobacco, the cure-all of yester years, is condemned as a likely cause of lung cancer and heart diseases. Currently, every Cigarette Packet bears the warning — "Cigarette Smoking is Hazardous to Health."

The United States of America, China and India raise among them more than 2 million tons of cured tobacco leaves. The proportion used in making cigarettes, pipe-tobacco, cigars, chewing tobacco, snuff, insecticides, etc. varies from year to year. Only modest changes followed the statistical proof in 1964 that tobacco-smoking leads to various causes of death (lung cancer, cancer of mouth, heart disease are some of them).

Another aspect of the tobacco plant is that it is the source of the poisonous substance, 'nicotine'. It is an alkaloid extracted from the plants of *Nicotiana tabaccum*. A single drop of the purified compound is fatal if applied to human skin. In extremely dilute solutions, it can be used as an insecticide to kill plant pests like caterpillars, etc.

For centuries, tobacco has remained an international commodity and till today it is. Any amount of warning against health hazards will not stop its use. It is heavily taxed but the users do not shrink from paying the tax. It is for us to decide whether it is a 'filthy weed' (from its looks) or a 'divine' plant (from its uses).



Plants of The Quran

PLANTS and plant products mentioned in the Holy Quran are quite similar to those mentioned in the Bible. The probable reason for this similarity may be because both these holy scripts have been written in similar landscape and environmental or climatic conditions, although the timings are separate. There are a number of Biblical verses on Quranic plants like Manna (*Alhagi maurorum*, *Tamarix mannifera*), Date palm (*Phoenix dactylifera*), Olive (*Olea europaea*), Grapes (*Vitis vinifera*), Pomegranate (*Punica granatum*), Cedrus (*Cedrus libani*), Henna (*Lawsonia inermis*) and many others (Farooqui 1997). The plants mentioned in Quran have special significance on account of their relevance to the events and happenings associated with them. Sometimes, it becomes essential to know the botanical aspect of these plants to understand the true meaning of the Quranic verses. We have selected only a few plants to include in this Chapter.

Mann

The Quranic name Al-Mann is for the English name Manna.

"And We gave you the shade of clouds and sent down to you manna and quails, saying : Eat of the good things We have provided

for you. (But they rebelled): to Us they did not harm, but they harmed their own souls."

The literal meaning of the word Mann in Arabic is favour or reward. But in general use it means a type of sugar-like (Sachharine) food-substance provided by God to the Children of Israel when they were roaming about in the desert of Sinai after their exile from Egypt.

According to some, 'Mann' is a sweet gum obtained from tamarisk trees (*Tamarix mannifera*), a common plant in the desert of Sinai. According to some other authors, 'Mann' is something like Honey-dew deposited on the leaves of certain plants and collected early in the morning. Although different persons at different times have emphasised it to be a plant, nobody ventured to actually identify the plant.

According to Farooqi (1997), 'Mann' of Quran is obtained from two different plants : *Alhagi maurorum* (Al-Haj or aqul in Arabic) and *Tamarix mannifera* (Gaz in Arabic). *A. maurorum* is a thorny shrub, up to three feet in height with a long penetrating root system sometimes reaching to a depth of 15 to 20 ft in the soil. It is a good fodder plant for camels. The plant is also reported from Iran and India, where it grows mainly on alkaline soils. Iran, at present, is the source of Mann called 'Turanjbin' from this plant. Probably, this exudate is formed due to an insect attack. That is why, formation of Mann is not reported from anywhere in India as the insect is not available here.

The other 'Mann'-producing plant, *Tamarix mannifera* is of common occurrence in Palestine, Syria, Iraq and Iran. A few species of *Tamarix* grow in India too, but none of them produce 'Mann'.

Mann from *Alhagi maurorum* (Turanjbin) and *Tamarix mannifera* (Gazanjbin) are traded in many parts of the world but they are used mainly for medicinal purposes. 'Turanjbin' is mostly supplied from

the Khorasan area of Iran and 'Gazanjbin' from northern parts of Africa. Its sweetness is due to the presence of sugars and sugar-alcohols. 'Mann' (in Quran) has been referred to with 'Salva', i.e. the bird Quail. These Quranic verses bring out clearly that a food consisting of sweet carbohydrate (Mann) as well as protein and fat (Salva) was provided to the Children of Israel, and who does not know that it is a balanced diet. Without this food, the people of Israel could not have survived for forty long years (1491 BC to 1451 BC).

The Quranic reference of 'shade of clouds' is also significant. From this it is derived that although the 'mann' - producing plants were large in number (to provide enough for so many people) they were not shady trees and hence, the almighty had to provide the shade of clouds for His children. Neither *Alhagi maurorum* (a small shrub) nor *Tamarix mannifera* (a small tree with scale leaves) are shade-producing.

Origin of the word 'Mann' is also quite unusual. In Semetic language (from which Hebrew and Arabic originated) 'Mann' means 'what' or 'who'. When the people of Israel saw the white substance around trees they might have asked each other 'what (Mann) it was?', and like this the word 'Mann' came to be attached to this new edible substance.

There are a few other plants which serve as minor sources of 'Mann'. *Fraxinus ornus* (Oleaceae) from Sicily is called 'Gibelman' (from Arabic Jabal Mann meaning Hills of Manna). *Cotoneaster nummularia* (Rosaceae) (from parts of Iran), a spreading plant on rocky surfaces is the source of a 'Mann' — 'Shirkhist' which is very sweet to taste. The 'Mann' exuding from this plant falls immediately on the surface of the rock and it appears as if the rock has exuded it. An alternate name 'Shirkhusk', is sometimes used which means 'dried milk'. *Astragalus adscendens* (Papilionaceae) is another source of Iranian'

Mann'. *Quercus incana* (Fagaceae) too is a good source of 'Mann'. Chemically, 'Mann' contains some free sugars and sugar alcohols like glucose, fructose, melizitose, dulcitol, mannitol and others. Although very much like gums obtained from various plants, 'Mann' is sweet to taste and highly nutritious (Farooqi 1997).

Cedar or Lote Tree

There was, for Saba aforetime, a Sign in their homeland — two Gardens to the right and to the left. "Eat of the Sustenance (provided) by your Lord, and be grateful to Him : a territory fair and happy, and a Lord Oft-Forgiving! But they turned away (from God), and We sent against them flood (released) from the Dams, and We converted their two Garden (rows) into 'gardens producing bitter fruit, and tamarinds, and some few (stunted) Lot-trees.'"

There are four such Quranic verses in which Lote trees have been mentioned. The word 'Sidrah' of the Holy Quran has been considered to be the Lote trees by most of the translators of Quran (Farooqi 1997). However, there is controversy about the identity of the Lote tree or 'Sidrah' whether it is *Ziziphus* or *Cedrus*?

According to Farooqi (1997), the three species of *Ziziphus* — *Z. mauritiana*, *Z. lotus* and *Z. spina-christi* (its thorns are said to have been used to make the crown-of-thorn for Jesus Christ), are spiny shrubs and may attain the height of small trees but never large, majestic trees. The edible fruits are not comparable to the other fruits (date-palm, pomegranate, fig, olive) mentioned in Quran. They are a good source of fuel but cannot be compared with any standard timber plant. These plants grow in tropical Africa and Asia but never in hilly regions with cold climate. In one of the Quranic verses the occurrence of 'Sidrah' has been mentioned in the cold, hilly areas of Yemen, at an altitude of 4000 ft above sea level, where *Ziziphus* cannot grow

wild. Moreover, plants of *Ziziphus* are not as graceful and useful as to be mentioned in the verses describing Paradise! Also, there is no mention of 'Sidrah' fruits. And this leads one to the probability of *Cedrus libani* as the 'Sidrah' or Lote tree of Quranic verses.

Cedar of Lebanon as it is called, is a majestic tree reaching a height of 150 ft with a trunk up to eight feet in diameter and often a girth of as much as 40 ft. Its branches at different heights are spread out in a way so as to give a terraced appearance. With its beautiful dark-green foliage the trees give a grand appearance. As Farooqi (1997) states, one is lost by the beauty of a Cedar tree or its forest. Cedar yields a quality timber — shiny, light, durable and pleasant-smelling (due to the presence of cedar oil). During the pre-Christian era many temples and palaces were using this timber. It is said that the palace of King Solomon (950 BC) was made of this wood for which a large number of these magnificent trees were felled down and transported to the capital Jerusalem. During the time of the Pharaohs also large forests of Cedar of Lebanon were cut down and taken to Egypt. It is said that Prophet Hazrat Mohammad condemned those who cut "Sidr". The Prophet's warnings against the destruction of these trees highlight his scientific attitude to conservation and maintenance of the ecological balance. According to Farooqi (1997) : if some forests of *Cedrus* are still in Lebanon and Syria today, it must have been because of the general attitude of the muslims against their cutting. There are some traditional uses of this plant also. It is advised that 'Sidr' leaves should be mixed with warm water for giving bath to the dead body. This is so because the essential oil present in these leaves is highly effective as deodorant and disinfectant. Leaves of *Cedrus libani*, *Juniperus oxycedrus* or even *Ziziphus lotus* or *Z. spina-christi* can be used for this purpose depending upon the availability. In another tradition, the cedar leaves are indicated to have anti-bacterial and

cleansing properties. For example, it is reported that Prophet Mohammad used to wash his head with 'Ragva' (lather) of 'Sidr' and that this practice was followed by earlier prophets also.

All these facts make one believe that the Quranic 'Sidrah' or 'Sidr' is most likely *Cedrus libani*. The use of the name Lote tree for this magnificent tree might have been a historical misunderstanding.

Henna or Camphor

"As to the Righteous they shall drink of a cup (of wine) mixed with Kafur,"

In this Quranic verse, a wine with a flavour of 'Kafur' is meant for consumption of those who live in 'Jannat' (Heaven or Paradise). In almost all translations of Quranic verses, this word 'kafur' has been understood to be the Camphor of plant origin. It has also been mentioned by some that the camphor of Heaven is different from the camphor of the Earth. In Arabic dictionaries, many different meanings of 'Kafur' are given : outer coverings of unripe bunches of grapes and dates, or the perfume from a certain type of deer.

If we study the historical background there are two different plant sources of the present-day camphor: *Dryobalanops aromatica* (Dipterocarpaceae) of Malaysia (known as Borneo or Sumatra Camphor, used chiefly in China) and *Cinnamomum camphora* (Lauraceae) of China. The former, also known as Qaisuri Kapur (imported from Qaisur in Malaysia) was much costlier as compared to the Chinese Kapur or Camphor. During the 13th Century AD, the price of Malaysian camphor was equal to that of gold. Even during the late 19th Century, its price was Rs 80/- per pound as compared to Rs1/- per two pounds of the Chinese variety. The important fact to find out is when did the Arabs come to know about camphor. Studies

show that during the pre-Christian era and even thereafter (next few Centuries after Christ) camphor was not known in Southern Europe, Egypt and Arabia. According to Hitti (1953), when the Arabs defeated the Iraqis and Persians in 673 AD, they came across a white substance (kept in a leather bag) in Persia and mistook it for salt. But they were told by the local people that it was used as a medicinal substance and called 'Kafur' in Persian language.

It is presumed that the Arabs knew about the Malaysian camphor only because of their old trade relations with India. They had no knowledge of Chinese camphor. It was only in the 13th Century that Marco Polo gave a detailed account of the camphor-producing trees of China. Hence, 'Kafur' seems to be the Persian derivation of Indian word 'Kapur' or 'Karpura' (Sanskrit). It is not an Arabic derivation. The Arabs did not have any knowledge of 'Kafur' before Islam, neither through trade with India nor through the Greek medicine. (There is no reference to camphor in books of medicine by Galen.)

But, the question remains that if 'Kafur' was not camphor then what was it that the Arabs used and find mention in the Quran?

The chemical nature of camphor is such that let alone mixing with wine (as mentioned in the Quranic verse) one cannot even drink water mixed with it. It appears therefore, that Quranic 'Kafur' is probably similar to Biblical 'Kopher' (Copher).

"Thy plants are an orchard of pomegranates, with pleasant fruits, 'Copher' with spikenard....."

Early translators of Bible, too, mistook copher to be 'Camphire' or Camphor. However, it had been shown beyond doubt that camphor was not known during the period of Holy Christ. The word 'Kopher' (Copher) was actually the name of 'Hinna' (*Lawsonia inermis*) in Semetic language. In old Greek literature, 'Hinna' was called 'Kufros'.

According to Farooqi (1997), this Quranic word 'Kafur' was actually derived from the Biblical word 'Kopher' (Hebrew) and Greek word 'Kufros' and not from Sanskrit 'Karpura' meaning camphor.

Lawsonia inermis is a common shrubby plant of the Arab countries. Its flowers yield a perfume — Itre Hinna — used as an important cosmetic. There are several references to 'Kafur' in many sayings of Prophet Hazrat Mohammad but none of them refer to any medicinal use of 'Kafur'. The Holy Prophet advised application of 'Kafur' on the dead body when the last rites were performed.

Camphor during those periods (6th and 7th Centuries) was not a common substance (commodity) in places like Hijaz Najd. Moreover, it was an imported substance and extremely costly. Hence, its use for applying on dead bodies could not have been a common practice. Whereas, 'Iitre Hinna' was a more common perfume in those areas and could have been used for this purpose. In Egypt too, use of Hinna on dead bodies was customary in ancient days.

Hence, keeping all these facts in view, 'Hinna' or *Lawsonia inermis* (Lythraceae) appears to be the 'Kafur' of Quran. It is a shrubby plant often grown as a hedge plant of our gardens. The spikes of greenish-yellow flowers are sweet-smelling and a paste made from its leaves when applied on palms and feet, leave a reddish-brown stain on drying. It is a common practice in Northern India to apply this paste on the palms and feet of the bride — a part of the bridal decoration and auspicious too.

There are a large number of other plants such as Toothbrush tree or *Salvadora persica* (Khamt), Arabian Acacia or *Acacia seyal* (Talh), Olive or *Olea europaea* (Zaitun), Pomegranate or *Punica granatum* (Rumman), Fig or *Ficus carica* (Teen), Grapes or *Vitis vinifera* (A'nab) and many others which find mention in the verses of the

Holy Quran. It is interesting to note that many of the Quranic names of plants, fruits and seeds have originated from Semetic as well as Greek language, and, therefore, many of them are similar to the names given in the Bible (Hebrew). For example, Olive has the Quranic name 'Zaitun' and Biblical name 'Zaith'; grapes in Quran are called 'Inab' and in Bible, 'Enav'; for Lentil, the Quranic name is 'Adas' and the Biblical name 'Adasha'.



The Fossil Resin : Amber

THE resin is a highly inflammable substance hardening on exposure to air. It is formed by secretion in trees and exudes naturally from many of them such as firs and pines, or obtained by incisions on the plant-body.

Gums and resins of the prehistoric coniferous trees have been discovered in fossilized state and are known as 'amber'. For the ancient Greek poets, 'amber' represented the tears shed by the Heliades after their grief over the death of their brother Phaeton had changed them into Poplars.

Amber is transparent or translucent and is of various colours : White, yellowish, red, brown or even black; sometimes clouded or streaked. It is found chiefly on the south shore of the Baltic Sea in Germany and Poland and is the most important amber of trade. The chemical nature of the Baltic amber proves it to be a resin from a number of extinct conifers of which *Pinus succinifera* is the principal source. These plants flourished during the Eocene (40 my - million years) on the shores of the Baltic.

The water-insoluble fossilized tree-resin attains a stable state after various changes such as loss of volatile constituents, oxidation

and polymerization processes, and a prolonged 'burial' period. Amber is a general word for resins that are heterogeneous and differ in chemical and physical properties. They occur throughout the world in widely-separated areas such as Burma, Japan, Alaska, North, South and Central America, and many European (Denmark and Sweden) as well as near-Eastern (Soviet Russia) countries.

Amber is exceedingly hard and brittle and softens at about 150°C. It occurs in various forms, the most important is 'succinite'. Amber is easily carved, takes a high polish and is characterized by a resinous lustre. It becomes negatively electrified when rubbed with a piece of cloth, and emits a characteristic aroma. The Greeks called it 'elektron' from which the word 'electricity' is derived.

The term amber (French 'ambre') is obtained from the Arabic 'anbar'. It was highly prized by the ancient people — like the Greeks and the Romans — for jewellery, beads, and other ornamental purposes. Amber has been used as gem, worn in string of beads by prehistoric man; often used as 'talisman'. It has also been used as means of exchange.

Certain magical powers have also been attributed to amber. At present it is used for the mouth-piece of pipes, and holders for cigars and cigarettes. Its use in medicine and X-ray therapy is also known. Human blood does not coagulate if kept in amber containers. The darker grades yield a valuable varnish.

Scientifically, amber is of interest because the remains of insects and plant materials become occasionally embedded in it. Evidence of its vegetative origin is provided by its deposition alongwith coal and fossil wood. The soft, sticky, and more or less fluid nature of the original (resinous) material is indicated as some of these specimens (ambers) contain perfectly preserved insects trapped in the resin.

These are valuable to scientists for the record they provide of ancient insect life.

Many hardened resinous tree gums : 'Kauri Gum' (*Agathis australis*) from New Zealand and 'Copal Gum' (*Copaifera demeuseii*) from Africa, are sometimes misrepresented as amber. These gums float on salt-water but true amber will sink because of its higher density. Baltic amber has relatively low melting point and, therefore, the waste (Scrap) material can be fused into 'cakes'. These cakes or 'amberoid' are very difficult to distinguish from natural solid amber. Many other substances are readily manufactured from celluloid, bakelite and Canada Balsam which are used as substitutes of amber. Its chemical composition is $C_{10}H_{16}O$.

Glossary of Technical Terms

Alkaloid	: A nitrogen-containing organic base, occur in plants; of medicinal value in lower doses, otherwise poisonous, e.g. morphine, atropine, hyoscyamine, etc.
Ancestor	: Progenitor of a more recent (species of) organism.
Anointing oil	: Oil that is applied as a sacred rite, especially for consecration.
Antidote	: A remedy that counteracts the effect of poisons.
Anther	: Pollen-bearing part of a flower.
Antispasmodic	: Used against spasms or violent muscular contractions.
Aromatic	: Fragrant.
Asphyxia	: Interruption of effective gaseous exchange in the lungs endangering the life of an individual.
Astringent	: A substance that causes contraction of skin and constriction of blood vessels and checks secretion.
Auricular	: (Aerterial) fibrillation – Arrhythmia marked by rapid, random contractions of muscular fibres of the auricular chamber of the heart.
Bract	: A small leaf-like structure at the base of a flower.
Brackish	: Slightly salty.
Carminative	: Relieving flatulence or gas in the gut.
Carpophore	: A wiry stalk (of carpillary origin) that supports each half of the dehiscing fruit.
Cauliflory	: Flowers and fruits borne directly on the stem and older branches.
Chef (of all spices)	: A skilled cook.
Clinging roots	: Roots of epiphytes that help in clinging to their support.
Corm	: A solid bulb-like stem usually borne subterranean as in <i>Gladiolus</i> .

Deciduous	: Trees in which leaves fall at the end of one season.
Dioecious	: Having male and female flowers on different plants
Diurectic	: Stimulating the flow of urine.
Dropsy	: Abnormal accumulation of water in the body tissues causing painful swellings
Dyspepsia	: Impaired digestion of food leading to symptoms of abdominal discomfort.
Dystrophy	: Disorder due to defective or faulty nutrition of any cell leading to nonfunctioning of the cell
Debility	: Loss of strength due to any disease.
Elliptic	: Oval in outline with narrowed to rounded ends and broad in the middle.
Embalm	: To treat (a dead body) so as to give protection against decay.
Embryo	: Develops from the zygote within an ovule; the rudimentary plant in the seed.
Endemic	: Native or confined naturally to a particular area or region.
Endosperm	: The starch-or oil-containing tissue of many seeds; usually around the embryo.
Essential oil	: Volatile, aromatic oil obtained from certain plant parts, e.g., Sandalwood oil from sandalwood.
Evergreen	: Plants (trees) that remain green throughout the year as all the leaves do not fall together.
Exhilaration	: Enlivening, invigorating.
Fermentation	: A chemical change with effervescence (usually of CO_2)
Flatulence	: Gas in the gut/stomach
Gene	: An unit of inheritance that is carried on a chromosome and controls the transmission of hereditary characters.
Gnarled	: Covered with knots and protuberances.
Hypertensive	: Abnormally high blood pressure.
Indigenous	: Originating; living naturally in a particular region.
Inflorescence	: An axis bearing flowers.
Infusion	: An extract obtained by steeping the drug in water.
Lanceolate	: (Leaf-shape) lens-like.
Longitudinal	: Length-wise

Malodorous	:	Smelling bad.
Masticatory	:	A substance that is chewed, e.g. betel leaf.
Mericarp	:	Each half of a dry dehiscent fruit - schizocarp.
Metabolic	:	The chemical reactions resulting in the synthesis and degradation of complex organic compounds.
Muscular twitching	:	Short, spasmodic contractions of the muscles.
Neurasthenia	:	An obsolete category of neurosis marked by chronic weakness and easy fatigability.
Node	:	A point on a stem where one or more leaves are borne.
Ovary	:	Ovule-bearing part of a pistil.
Palmately-compound	:	Lobed or divided in a palmately or palmlike (or handlike) fashion, usually leaves.
Perennial	:	A plant living for several years usually with new herbaceous growth each year.
Perisperm	:	Persistent nucellar nutritive tissue in certain seeds, e.g. Blackpepper
Pharmacopoeia	:	An official book describing drugs, chemicals and medicinal preparations.
Phenolic compounds	:	Metabolic by-products, lack nitrogen.
Pinnate	:	Feather-formed; when leaflets are borne on two sides of the central rachis.
Pistillate flowers	:	Female flowers.
Placenta	:	The part of the ovary to which the ovules are attached.
Pollination	:	Transfer of pollen grains from the dehiscing anther to receptive stigma.
Poultice	:	A soft, usually heated and sometimes medicated mass spread on a cloth and applied to an inflamed or injured part of the body.
Receptacle	:	An enlarged or elongated end of the stem or floral axis which bears floral parts.
Resuscitate	:	To revive from apparent death or revitalise.
Rosette	:	An arrangement of leaves radiating from a crown or center, usually close to the ground.
Saponin	:	A glycoside with the property of lowering the surface tension of water and hence causes foaming. Cause haemolysis and are highly poisonous to fish.

Scroll	: A written document in the form of a roll.
Sedative	: Induces sleep, or soothing action.
Shrub	: A woody perennial plant that branches near to the ground.
Solvent	: A liquid capable of dissolving other substances.
Spathe	: A leafy sheath at the base of inflorescence, protecting it in young condition.
Spike	: Usually unbranched, elongated, simple, indeterminate inflorescence with sessile flowers.
Spikelet	: A secondary spike.
Sprig	: A small shoot or twig.
Staminate flower	: Male flower; with only the whorl of stamens.
Stigma	: The part of a plant's female reproductive organs (carpels), concerned with the reception of pollen.
Stimulant	: Increasing or accelerating the level of activity.
Stone mortars	: A bowl-shaped vessel made of stone in which substances are ground with a pestle.
Stomachic	: Beneficial to the stomach or stimulate digestion.
Stylopodium	: A disc-like enlargement at the base of the style as in some Umbellifers
Subcutaneous	: Under the skin.
Suckers	: An underground runner (stem) that soon grows up and forms a separate plant after forming roots, commonly seen in Chrysanthemums.
Syconium	: A special type of a cup-like inflorescence with a narrow opening at the top, as seen in figs; male and female flowers (two types) are borne on the inner surface.
Tabasco	: A pungent condiment sauce made from hot chilli peppers.
Tabernacle	: A receptacle for the consecrated bread and wine used at Communion.
Tannin	: A plant product with astringent properties; used in processing leather.
Terpenes	: A compound built up around one or more similar chemical units (isoprene). Terpenes range from camphor to rubber (a polyterpene) and include the resins.
Therapeutic	: Remedial agents or methods used in the treatment of diseases or disorders.
Toxic	: Poisonous.

Toxicology	: Derived from the Greek term 'Toxicom' meaning poison.
Trifoliate	: A compound leaf with three leaflets.
Twig	: A young leafy branch of stem.
Umbel	: An indeterminate, often flat-topped inflorescence whose pedicels (stalk of 1 flower in a cluster) and peduncles (stalk of a flower cluster) arise from a common point resembling the 'rays' of an umbrella; common in the family Umbelliferae.
Vector	: An agent that causes dissemination (spread) of a pathogen (disease-causing organism).
Vitta	: An aromatic oil tube in the fruit wall of the umbelli-ferous fruits (spices).
Volatile	: Capable of vaporizing at a relatively low temperature; usually aromatic oils.
X-Ray	: An electromagnetic radiation of very short wavelength that has the properties of ionizing a gas when passing through it, and of penetrating various thicknesses of all solids.
Xerophytes	: Plants that are adapted to grow in dry conditions caused by lack of water in the soil/atmosphere or extreme heat or both, e.g. desert plants.

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